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Radio
Test Report

EUT Name: Powerview Motorized Shades

Model Name: 1004000722, 1012000246, 1012000416, 1012000236, 1012000369

CFR 47 Part 15.247: 2021 and RSS 247: 2017

Prepared for:

Hunter Douglas Window Fashions Division
1 Duette Way
Broomfield, CO, 80020
U.S.A.

Prepared by:

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Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
0	05/27/2021	Original Document	RK

Note: Latest revision report will replace all previous reports.

Statement of Compliance

Manufacturer:	Hunter Douglas Window Fashions Division 1 Duette Way, Broomfield, CO, 80020, USA
Requester / Applicant:	Hunter Douglas Window Fashions Division
Name of Equipment:	Powerview Motorized Shades
Model No.	1004000722, 1012000246, 1012000416, 1012000236, 1012000369
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247: 2021 and RSS 247: 2017
Test Dates:	May 21, 2021 to May 25, 2021

Guidance Documents:

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v05r02

Test Methods:

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v05r02

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

Rachana Khanduri		Richard Decker	
Prepared By	Date May 27, 2021	Reviewer Signatory	Date May 27, 2021

Testing Cert #3331.02 **US1131** **2932D**

1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247: 2021 and RSS 247: 2017 based on the results of testing performed on May 21, 2021 to May 25, 2021 on the 1012000416 manufactured by Hunter Douglas Window Fashions Division. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 2402 MHz to 2480 MHz frequency band for Bluetooth, Low Energy is covered in this document.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C 63.10 & C63.4	Worse Case (Measured)	Result
Maximum Output Power	CFR47 15.247 (b), RSS 247 Sect. 5.4 (d)	7.08 dBm @ 2480MHz Channel, 1Mbps	**Complied**
DTS Bandwidth (6dB)	CFR47 15.247 (a)(2), RSS 247 Sect. 5.2 (a)	0.726MHz @ 2402MHz Channel, 1Mbps	**Complied**
Peak Power Spectral Density	CFR47 15.247 (e), RSS 247 Sect. 5.2 (b)	-7 dBm/ kHz @ 2402MHz channel, 1Mbps	**Complied**
Out of Band Emissions: Non-Restricted	CFR47 15.247 (d), RSS 247 Sect.5.5	-23.00 dBc @ 2400 MHz, Lower Band Edge	**Complied**
Out of Band Emissions: Restricted	CFR47 15.205, RSS GEN Sect.8.10	-1.320dB margin @ 2483.5 MHz, Average	**Complied**
Transmitter Spurious Emissions	CFR47 15.209, CFR47 15.247 (d), RSS-GEN Sect.8.9	-0.13dB Margin @ 4803.53MHz, Average	**Complied**
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.8.8	EUT is DC powered	**N/A**

Note: This test report covers 2400 MHz to 2480 MHz band.
Class B limits were applied where applicable.
N/A = Test not applicable since EUT is DC powered.

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA. 94538, are recognized by the Commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Pleasanton Registration No. US1131, Fremont Registration No. US1131). The laboratory Scopes of Accreditation include Title 47 CFR Parts 15, 18 and 90. The accreditations are updated every three years.

2.1.2 A2LA

TUV Rheinland of North America EMC test facilities are accredited by the American Association for Laboratory Accreditation (A2LA). The laboratories have been assessed and accredited by A2LA in accordance with ISO Standard 17025:2017 (Testing Certificate #3331.02). The Scope of Laboratory Accreditation includes emission and immunity testing. The accreditations are updated annually.

2.1.3 Industry Canada

The Pleasanton 5-meter Semi-Anechoic Chamber, Registration No. 2932M-1, has been accepted by Industry Canada to perform testing to 3 and 5 meters based on the test procedures described in ANSI C63.4-2014. The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D-1, has been accepted by Industry Canada to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2014.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5051 Brandin Ct, Fremont, CA. 94538, have been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0326

VCCI Registration No. for Fremont: A-0327

2.1.5 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

2.2 Test Facilities

Test facilities are located at 5015 Brandin Ct, Fremont, California, 94538, USA and 1279 Quarry Lane, Pleasanton, California 94566, USA (Fremont is the Pleasanton Annex).

2.2.1 Emission Test Facility

The Semi-Anechoic Chambers and AC Line Conducted measurement facilities used to collect radiated and conducted emissions data have been constructed in accordance with ANSI C63.7:1992. The Fremont 10 meter semi-anechoic chamber has been measured in accordance with and verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2014 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04), at test distances of 3 and 10 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02). The Pleasanton 5 meter semi-anechoic chamber has been verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2009 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04) at a test distance of 3 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02).

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurement and the fraction may be viewed as the coverage probability or level of confidence of the interval.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.3.2 Measurement Uncertainty

Per CISPR 16-4-2	**U_{lab}**	**U_{cispr}**
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.3 dB

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2017. Equipment calibration records are kept on file at the test facility.

3 Product Information

3.1 Product Description

The 1004000722, 1012000246, 1012000416, 1012000236, 1012000369 is assembled into various motor assemblies and fabricated into Hunter Douglas window coverings that include a fabric member that is rolled around an aluminum tube, or stacked on itself without a tube. The DC brushed motor rotates the tube to deploy and retract the fabric. The system is powered by 12-18VDC via DC power supply or primary batteries. This power is fed to a solid state H bridge to switch power to the DC brushed motor. Torque and speed are monitored and controlled with the use of hall sensors/ quadrature encoder and current measurement. The input power is dropped by a 3.3V switching power supply at 2MHz to feed power to the logic level components of the system. User inputs to the system include a push button on the motor module, a TTL level serial port, and 2.4GHz RF signals. The RF protocol used is Bluetooth 5 (Low Energy) and is implemented with Nordic NRF52840 series SoC (system on chips).

Model differences:

1004000722 PCBA, PV3 LUM 2.0

1012000246 PCBA, PVG3, NPD, STK, MAIN

1012000416 PCBA, PVG3, NPD, RLR

1012000236 RECVR; PVG3, SAT RCVR, PCBA

1012000369 PCBA, PVG3, NPD, AC RADIO

Model 1012000416 is considered worst case and used for testing.

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of a EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of a EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing.

3.4 Unique Antenna Connector

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.4.1 Results

The Powerview Motorized Shades has 1 dedicated Bluetooth removable antenna that has maximum gain of 1.58 dBi. It is not easily accessible to the end user.

It is integrated into the PCB of the device and is not easily accessible to the end user.

3.5 Duty Cycle

Model 1012000416 was measured for the duty cycle.

3.5.1 Results

Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Factor (dB)
BLE-1Mbps	100	0	100	0
BLE-2Mbps	100	0	100	0
Notes: EUT was configured and measured for the duty cycle. All measurements use 100% duty cycle.				

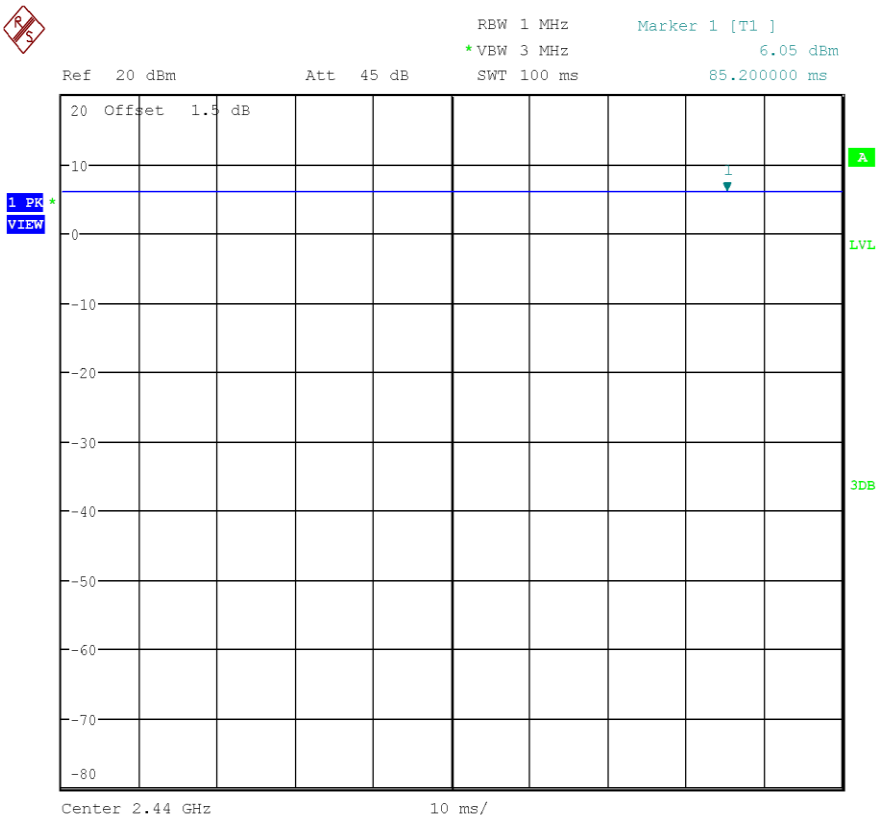


Figure 1: BLE-1Mbps Duty Cycle

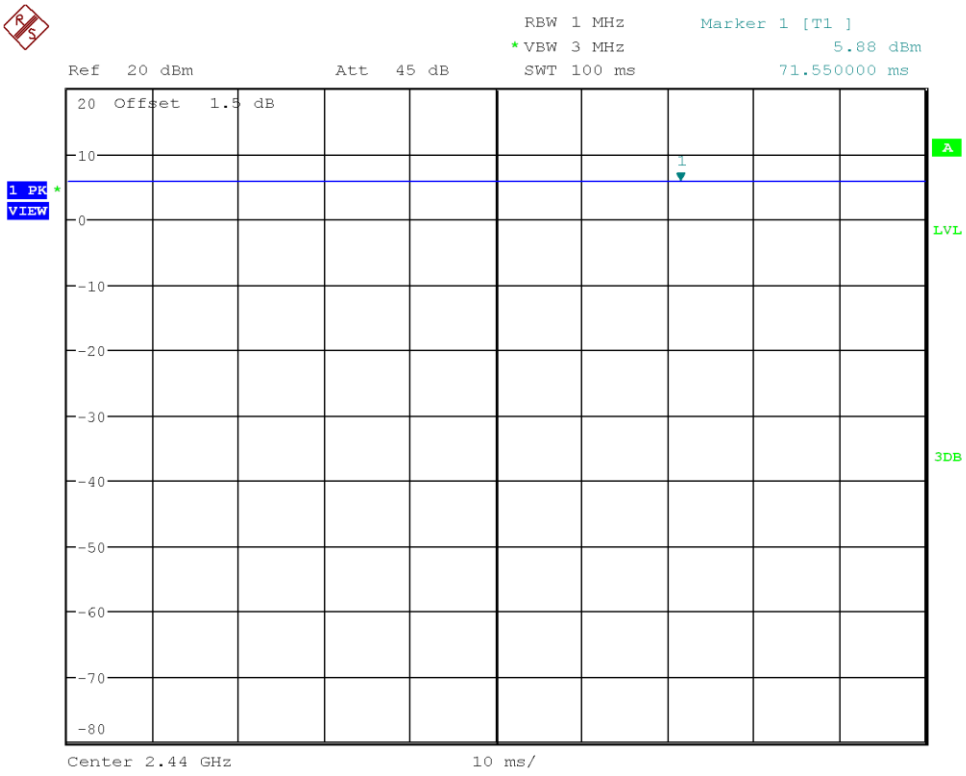


Figure 2: BLE-2Mbps Duty Cycle

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2021 and RSS 247: 2017. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

4.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

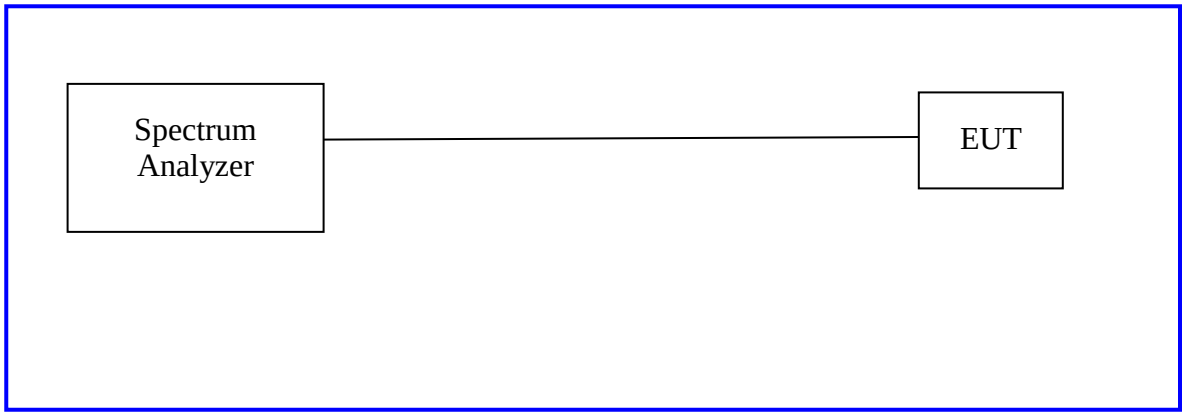
The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b) and RSS 247 Sect. 5.4.(d).

The maximum transmitted power in the frequency band 2400-2483.5 MHz: 1 W

4.1.1 Test Method

Conducted method was used to measure the channel power output. The worst findings were conducted on 3 channels in each operating range per CFR47 Part 15.247(b) and RSS 247 Sect. 5.4(d); 2400 MHz to 2483.5 MHz The worst mode results indicated below.

4.1.2 Test Setup: (Conducted)



4.1.3 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s). Worse case data for each mode reported below. Plots of highest power included for low, medium, and high channels.

Table 2: RF Output Power at the Antenna Port – Test Results

Test Date: May 21, 2021		**Test By:** Rachana Khanduri		
Test Method: Conducted Measurements		**Power Setting:** +8 dBm		
Antenna Type: Removable		**Max. Antenna Gain:** 1.58 dBi		
Ambient Temp.: 21 °C		**Relative Humidity:** 37%		
Bluetooth LE – RF Output Power				
Data Rate	**Operating Channel (MHz)**	**Measured Peak Output [dBm]**	**Limit [dBm]**	**Margin [dB]**
1Mbps	2402	6.90	+30.00	-23.10
	2440	6.96	+30.00	-23.04
	2480	7.08	+30.00	-22.92
2Mbps	2402	6.99	+30.00	-23.01
	2440	6.90	+30.00	-23.10
	2480	7.00	+30.00	-23.00
Note: The EUT transmitted at 100% duty cycle. The highest power output observed was at 1 Mbps				

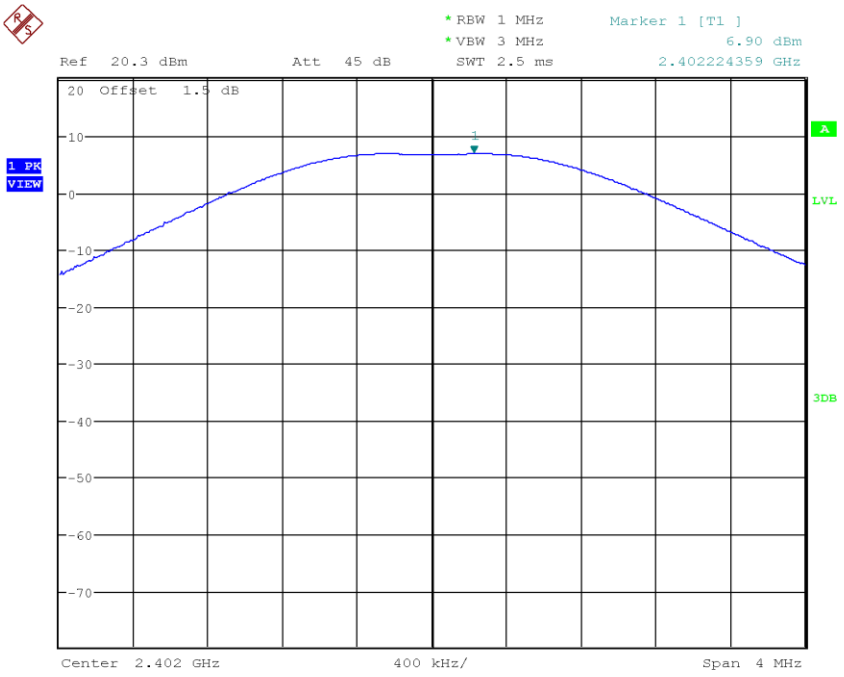


Figure 3: Maximum Conducted Power, 2402 MHz, 1Mbps

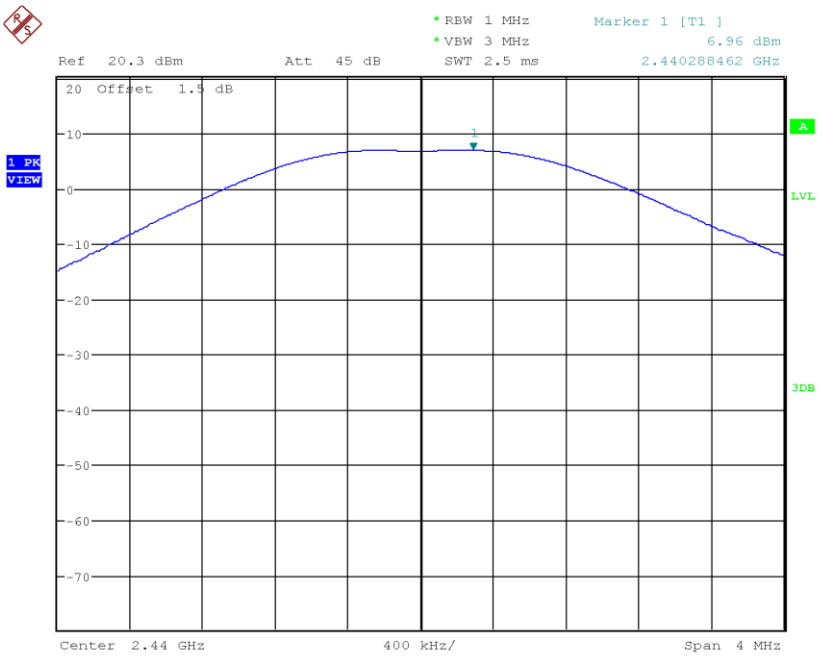


Figure 4: Maximum Conducted Power, 2440MHz, 1Mbps

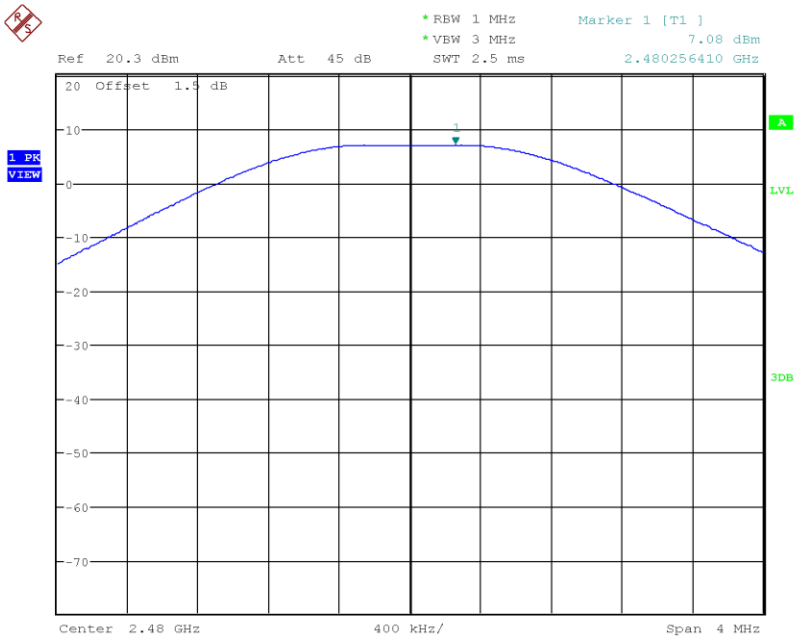


Figure 5: Maximum Conducted Power, 2480MHz, 1Mbps

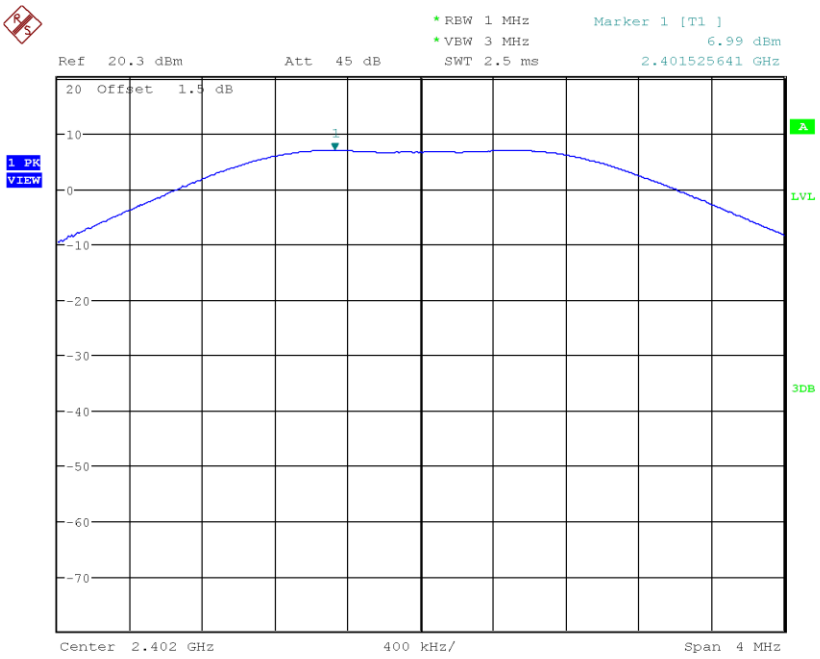


Figure 6: Maximum Conducted Power, 2402 MHz, 2Mbps

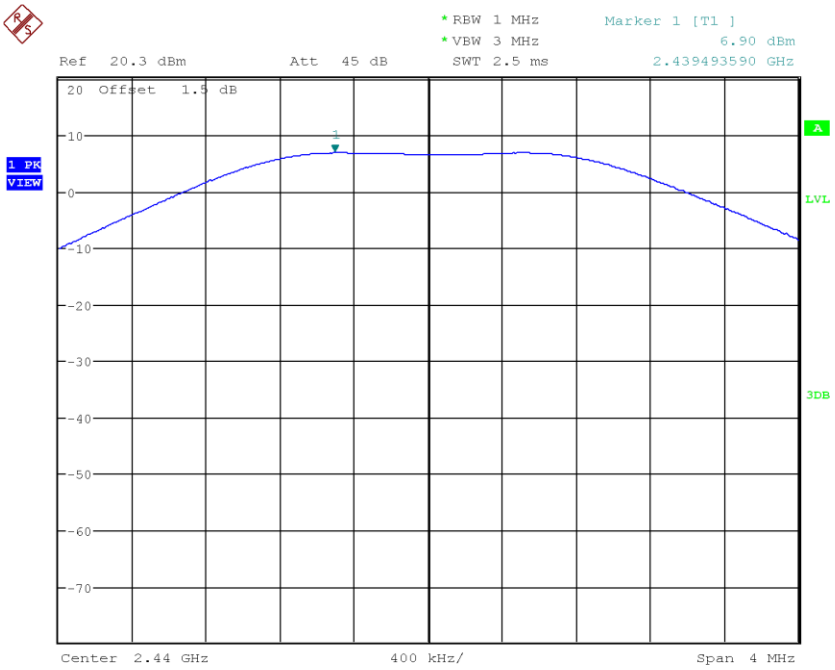


Figure 7: Maximum Conducted Power, 2440MHz, 2Mbps

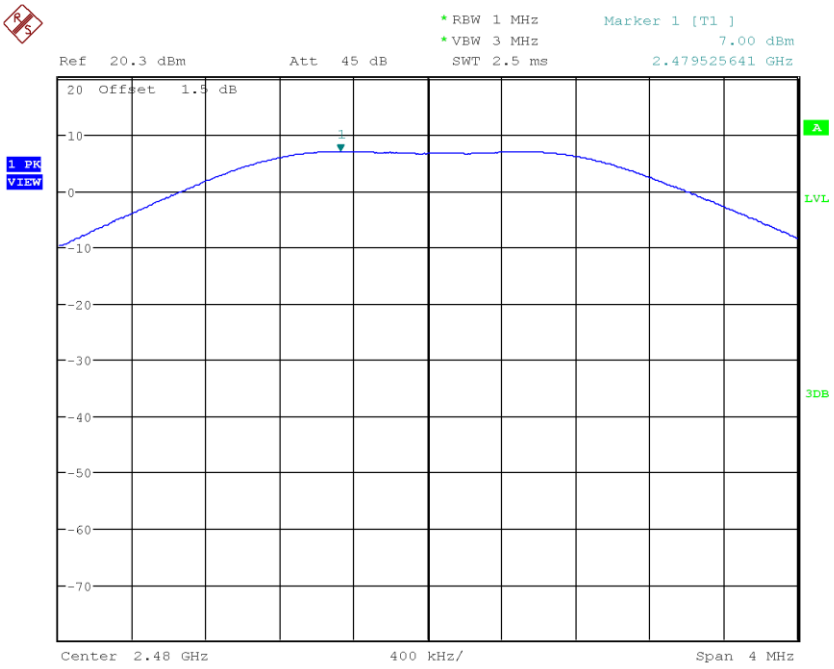


Figure 8: Maximum Conducted Power, 2480MHz, 2Mbps

4.2 DTS Bandwidth (6dB) and Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

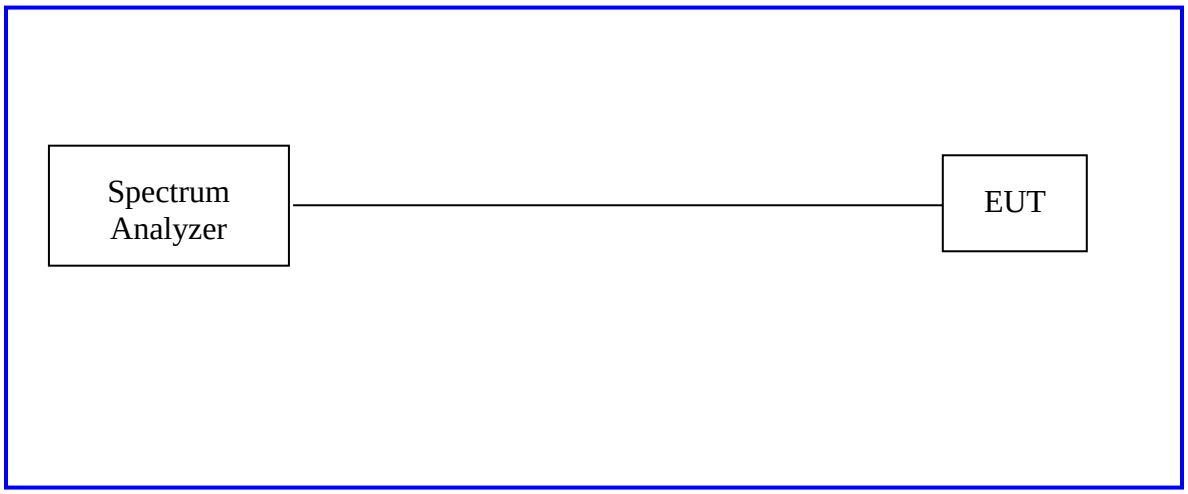
The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

The minimum 6 dB bandwidth shall be at least 500 kHz.

4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth according to ANSI C63.10:2013 Section 11.8. The measurement was performed with modulation per CFR47 15.247 (a) (2) and RSS Gen Sect. 6.6. Measurements were performed on the low, middle and high channels of the operating frequency range; 2400 MHz to 2483.5 MHz.

4.2.2 Test Setup: (Conducted)



4.2.3 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 3: Occupied Bandwidth – Test Results

Test Date: May 21, 2021	**Test By:** Rachana Khanduri
Test Method: Conducted Measurements	**Power Setting:** +8 dBm
Antenna Type: Removable	**Max. Antenna Gain:** 1.58 dBi
Ambient Temp.: 21 °C	**Relative Humidity:** 37%

Bluetooth LE – Occupied Bandwidth

Data Rate	Operating Channel (MHz)	99% Bandwidth (MHz)	6dB (DTS) Bandwidth (MHz)
1Mbps	2402	1.072	0.726
	2440	1.072	0.731
	2480	1.077	0.745
2Mbps	2402	2.083	1.218
	2440	2.091	1.282
	2480	2.091	1.290

Note: The narrower bandwidth was measured at 1 Mbps and 100% duty cycle.

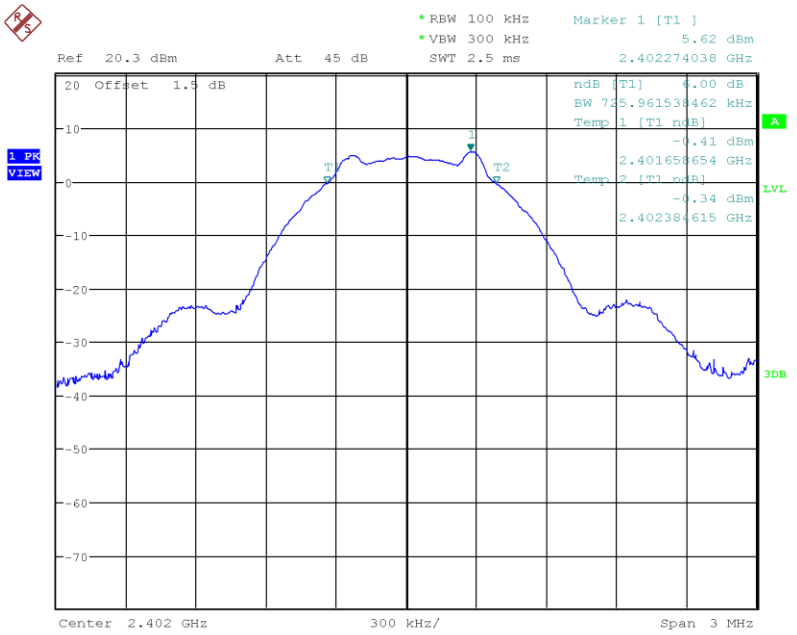


Figure 9: 2402MHz, 1Mbps, 6dB Bandwidth

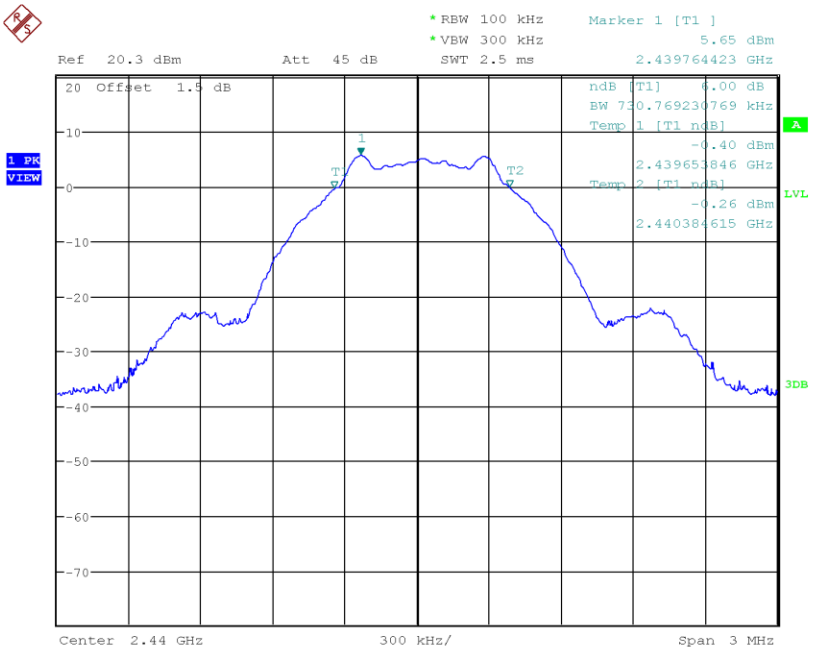


Figure 10: 2440MHz, 1Mbps, 6dB Bandwidth

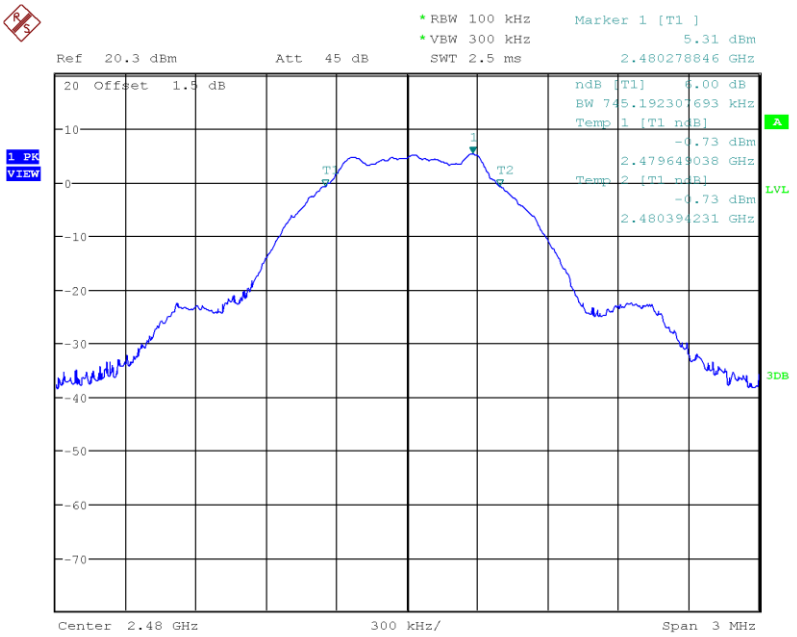


Figure 11: 2480MHz, 1Mbps, 6dB Bandwidth

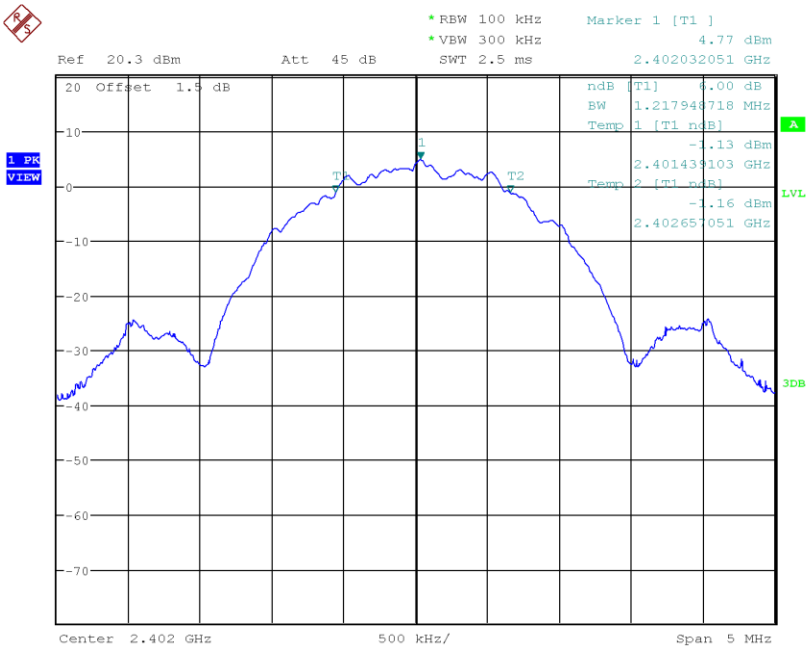


Figure 12: 2402MHz, 2Mbps, 6dB Bandwidth

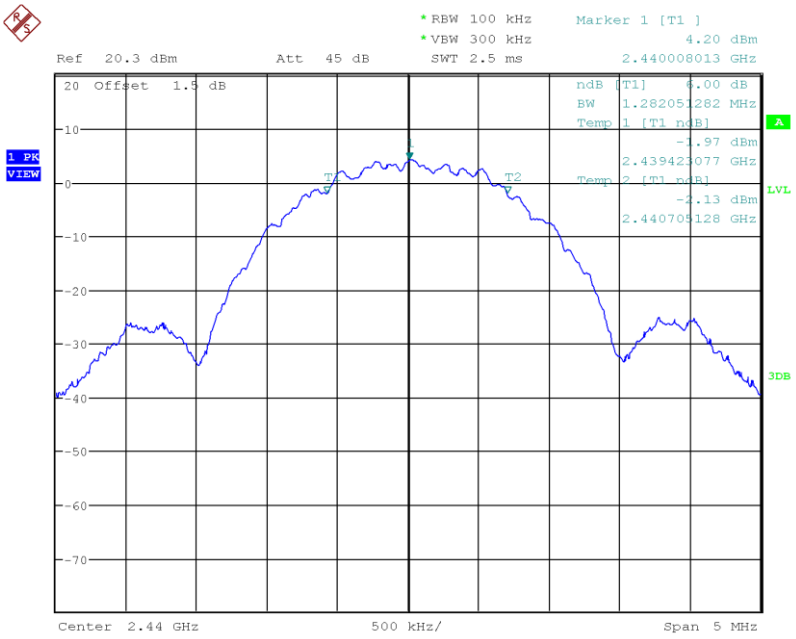


Figure 13: 2440MHz, 2Mbps, 6dB Bandwidth

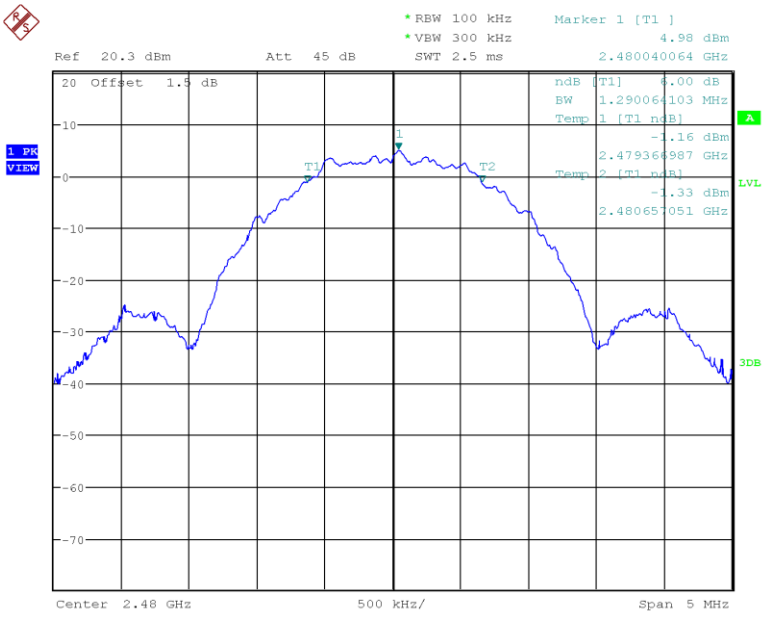


Figure 14: 2480MHz, 2Mbps, 6dB Bandwidth

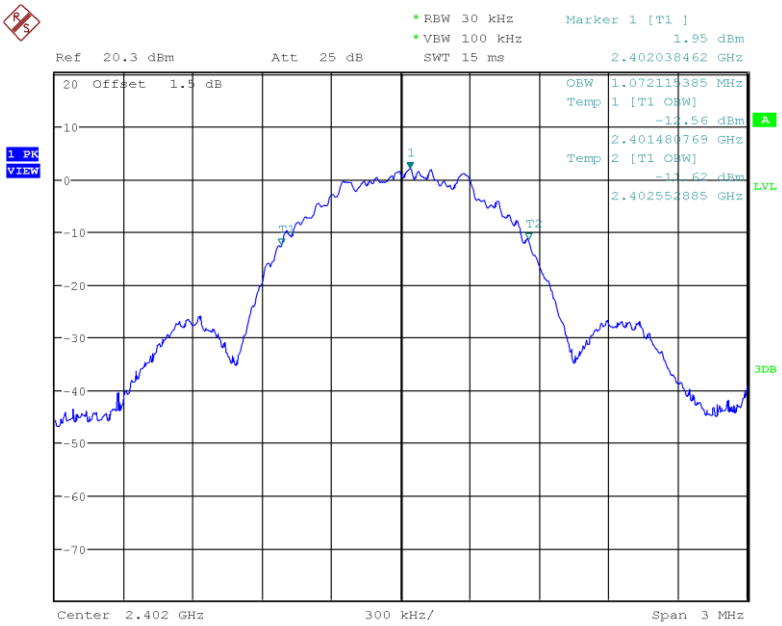


Figure 15: 2402MHz, 1Mbps, 99% Bandwidth

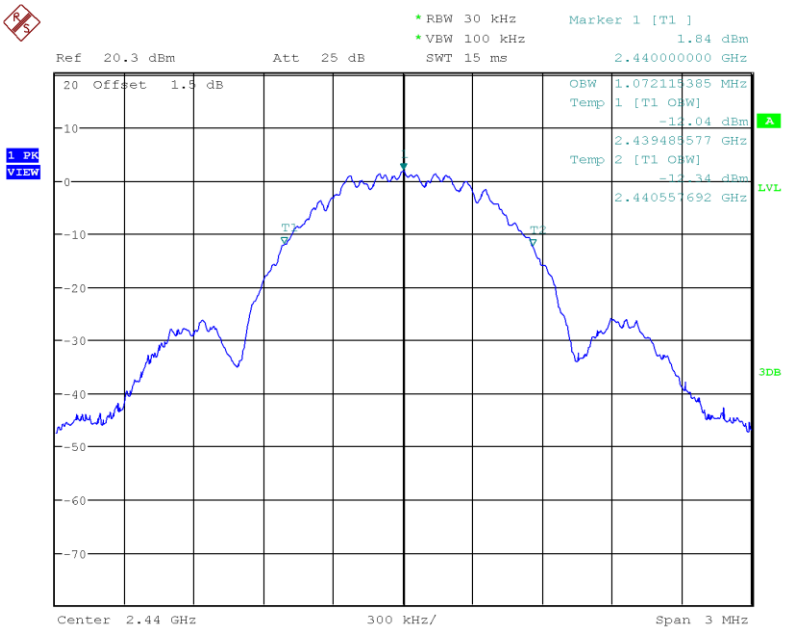


Figure 16: 2440MHz, 1Mbps, 99% Bandwidth

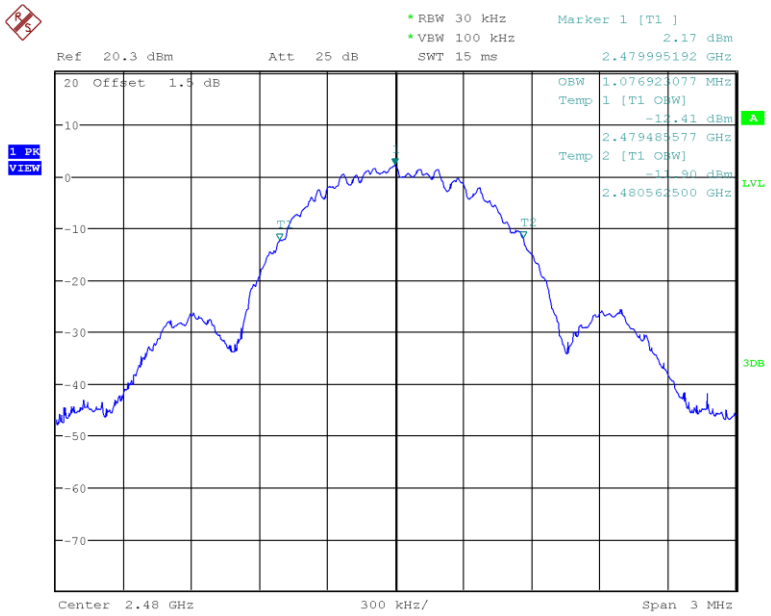


Figure 17: 2480MHz, 1Mbps, 99% Bandwidth

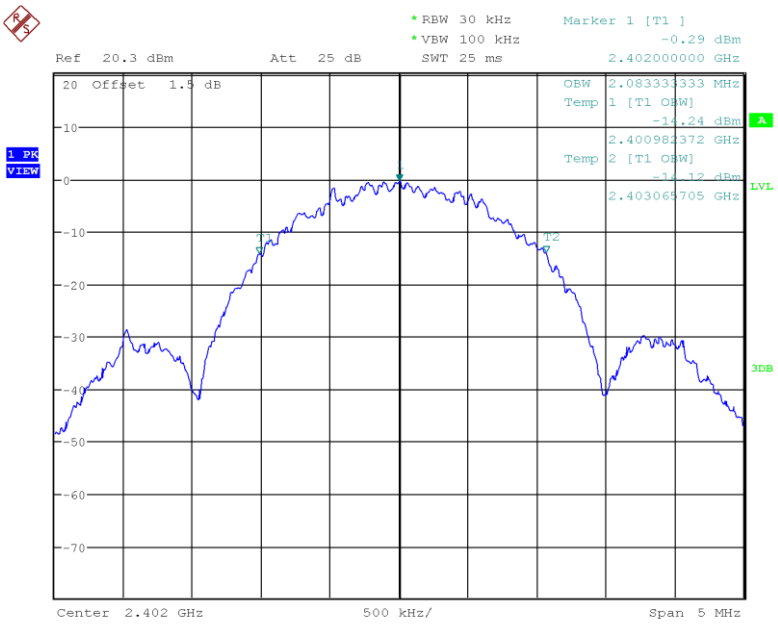


Figure 18: 2402MHz, 2Mbps, 99% Bandwidth

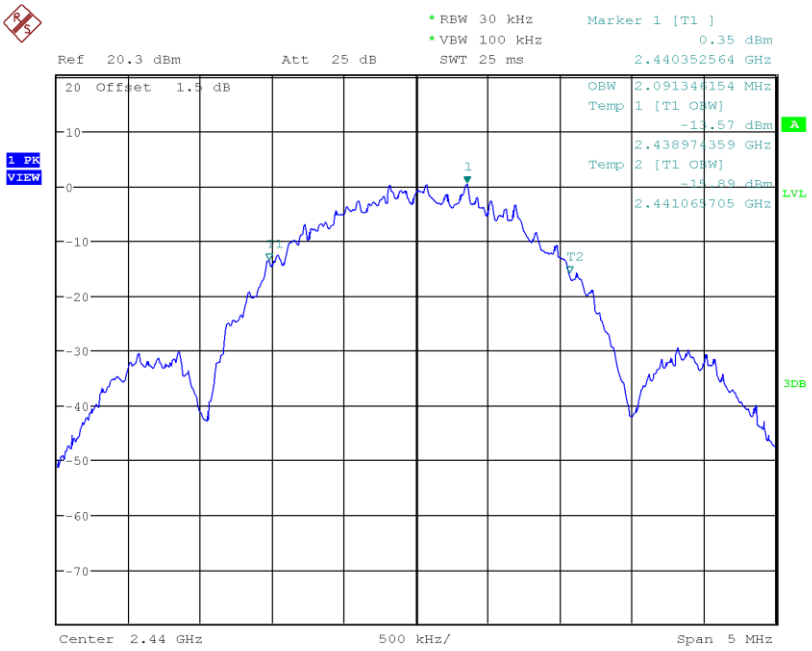


Figure 19: 2440MHz, 2Mbps, 99% Bandwidth

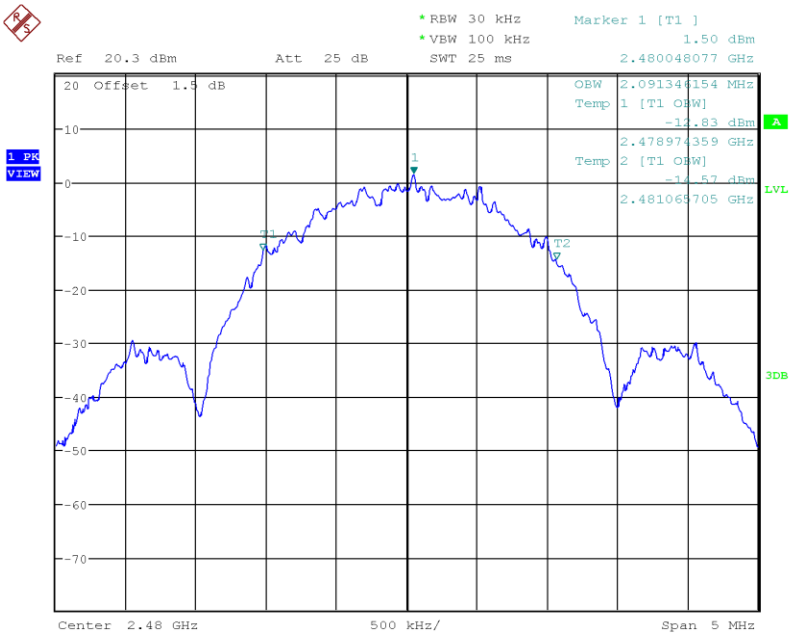


Figure 20: 2480MHz, 2Mbps, 99% Bandwidth

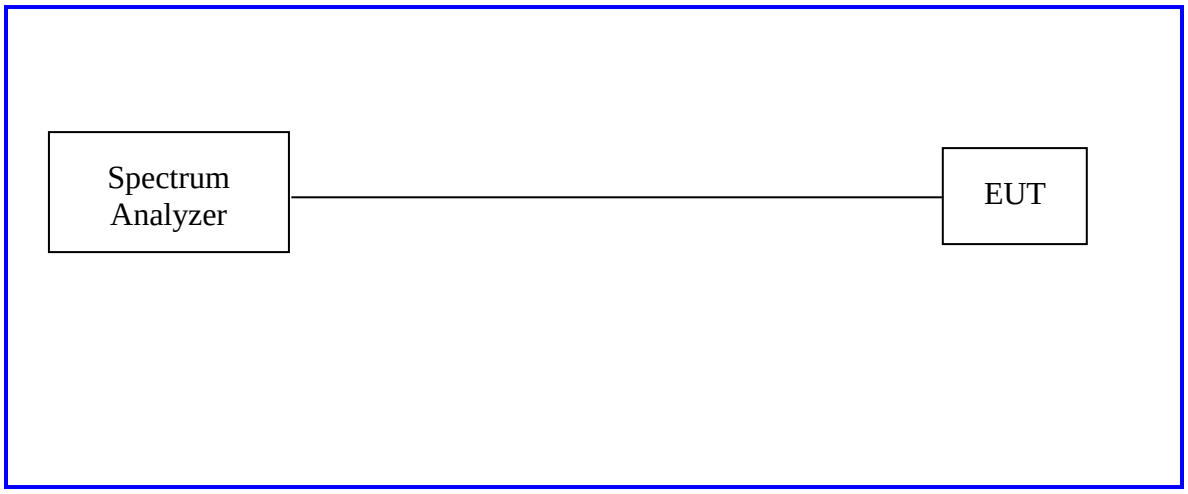
4.3 Peak Power Spectral Density

According to the CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b), the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.3.1 Test Method

The conducted method was used to measure the channel power output per ANSI C63.10-2013 Section 11.10.2. The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b). The worst findings were conducted on 3 channels in each operating frequency range of 2400 MHz to 2483.5 MHz.

4.3.2 Test Setup: (Conducted)



Method PKPSD of "KDB 558074 – DTS Measurement Guidance v04" was used.

4.3.3 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 4: Peak Power Spectral Density – Test Results

Test Date: May 21, 2021	**Test By:** Rachana Khanduri
Test Method: Conducted Measurements	**Power Setting:** +8 dBm
Antenna Type: Removable	**Max. Antenna Gain:** 1.58 dBi
Ambient Temp.: 21 °C	**Relative Humidity:** 37%

Bluetooth LE – Peak Power Spectral Density

Data Rate	Operating Channel (MHz)	Total PSD [dBm/kHz]	Limit [dBm/3kHz]	Margin [dB]
1Mbps	2402	-7.00	8.0dBm /3kHz	-15.00
	2440	-7.23	8.0dBm /3kHz	-15.23
	2480	-7.23	8.0dBm /3kHz	-15.23
2Mbps	2402	-8.60	8.0dBm /3kHz	-16.60
	2440	-10.15	8.0dBm /3kHz	-18.15
	2480	-9.36	8.0dBm /3kHz	-17.36

Note: The EUT transmitted at 100% duty cycle.

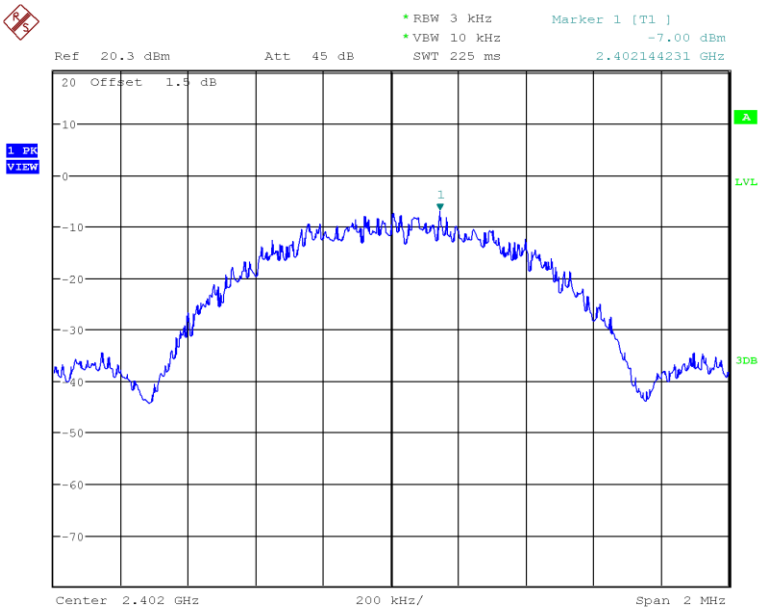


Figure 21: 2402 MHz, 1Mbps, PSD

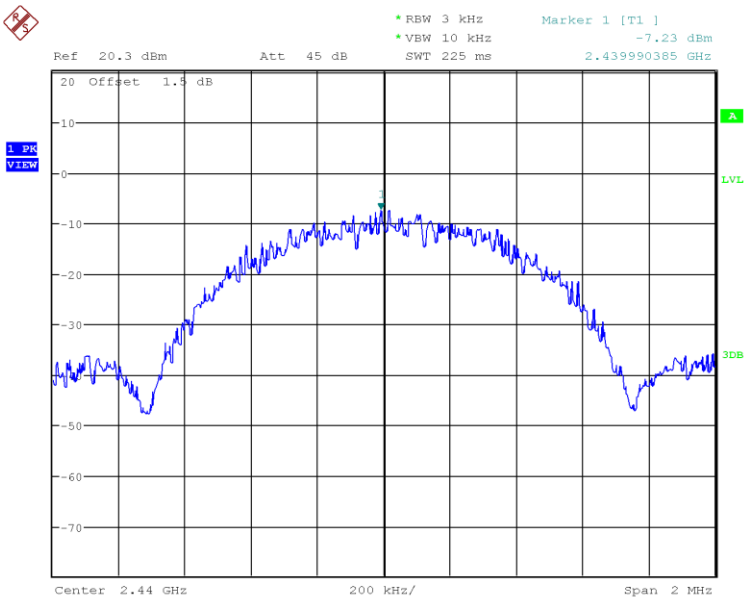


Figure 22: 2440 MHz, 1Mbps, PSD

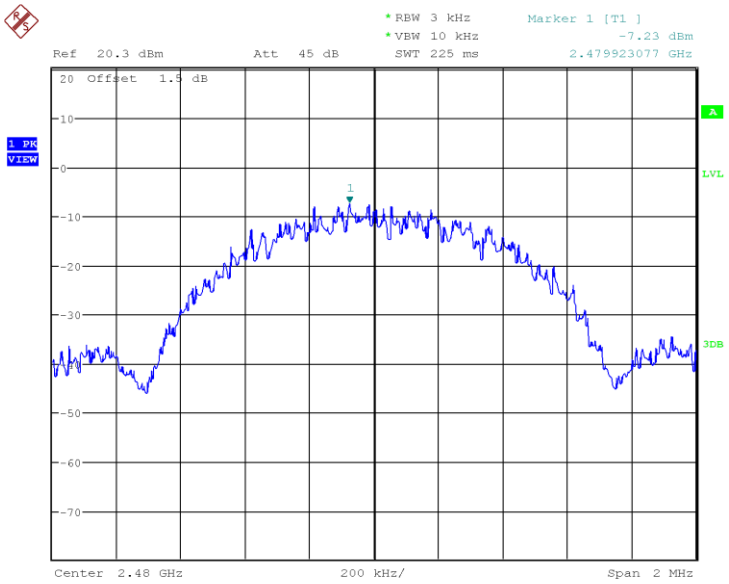


Figure 23: 2480MHz, 1Mbps, PSD

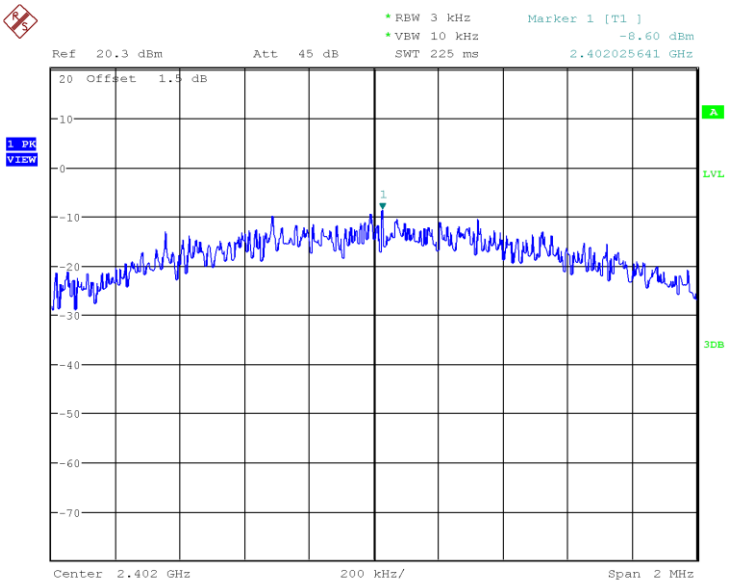


Figure 24: 2402 MHz, 2Mbps, PSD

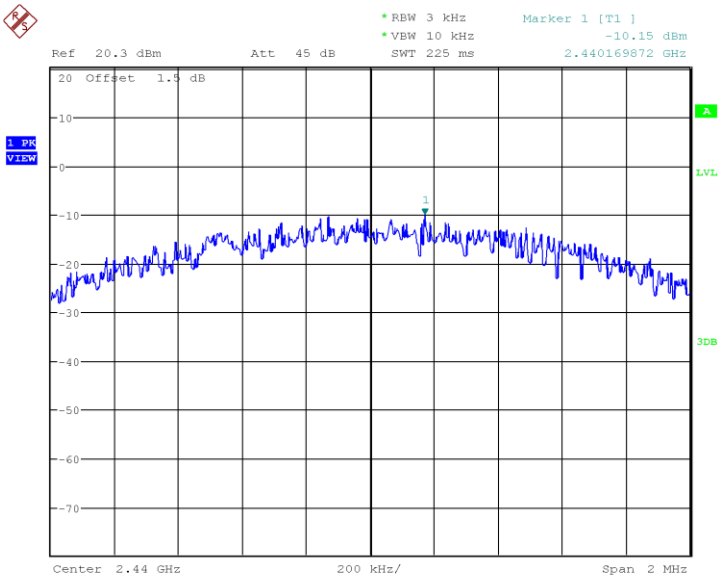


Figure 25: 2440 MHz, 2Mbps, PSD

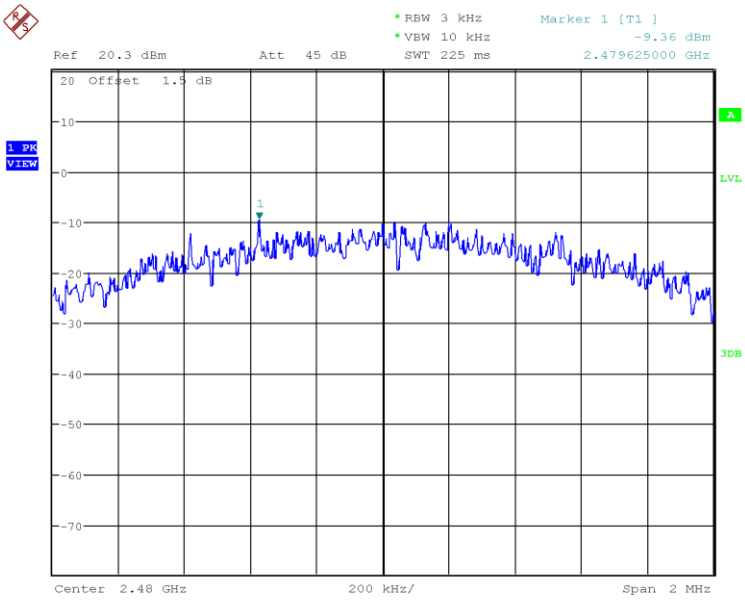


Figure 26: 2480MHz, 2Mbps, PSD

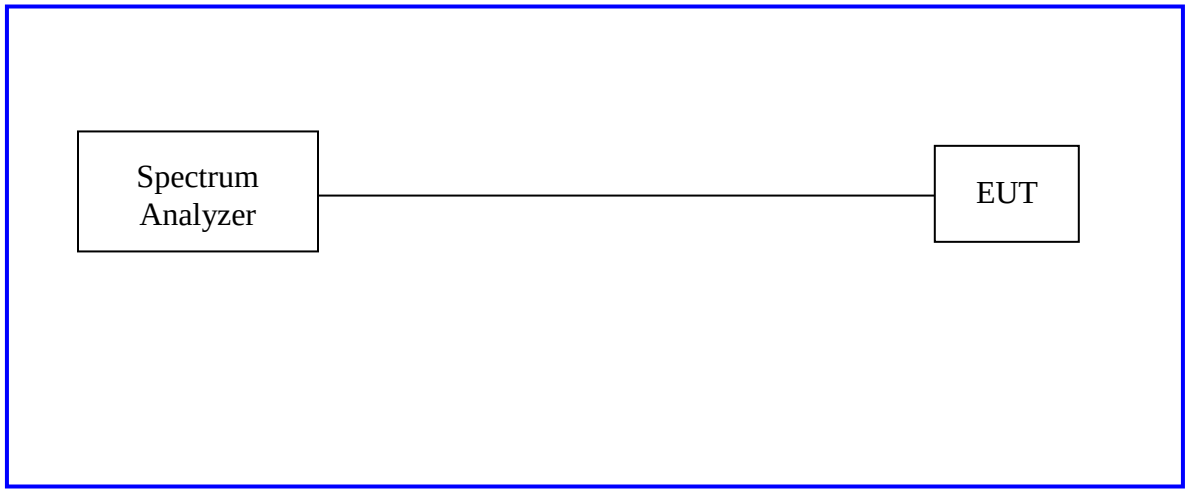
4.4 Out of Band Emissions: Non-Restricted Bands

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS-247 Sect. 5.5, RSS-GEN Sect. 8.9 and 8.10.

4.4.1 Test Method

Conducted measurements per ANSI C63.10-2013 Sections 6.10, 11.11, 14.3.3 were used to measure the undesirable emission requirement in non-restricted bands. The measurement was performed with modulation. The measurement was conducted from 30MHz to 26.5GHz on 3 channels in each mode on the EUT. Band edge tests were conducted on the low and high channel of each mode. The worst case measurement of each mode is recorded in this report.

4.4.2 Test Setup: (Conducted)



4.4.3 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 5: Emissions at the Band-Edge – Test Results

Test Date: May 24, 2021	**Test By:** Rachana Khanduri
Test Method: Conducted Measurements	**Power Setting:** +8 dBm
Antenna Type: Removable	**Max. Antenna Gain:** 1.58 dBi
Ambient Temp.: 21 °C	**Relative Humidity:** 37%

Bluetooth LE – Emissions at the Band-Edge

Data Rate	Band Edge	Center Freq (MHz)	Out of Band Level (dBm)	20dBc Level (dBm)	Measured Freq (MHz)	Results
1Mbps	Low	2402	-30.81	-13.92	2400.0	Pass
	High	2480	-39.71	-14.35	2483.5	Pass
2Mbps	Low	2402	-23.00	-14.57	2400.0	Pass
	High	2480	-40.06	-15.56	2483.5	Pass

Note: dBc is defined as the level below the main carrier.
The band-edge level must be lower than the 20dBc level.

4.4.3.1 Band Edge - conducted

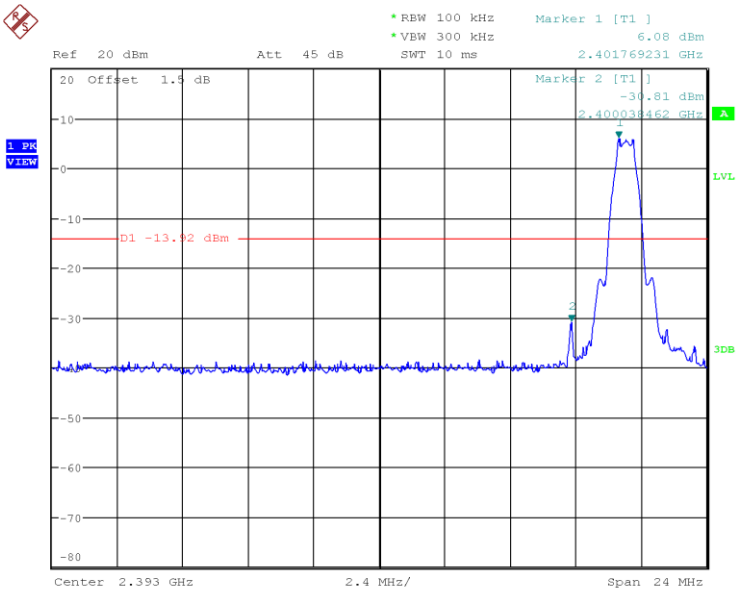


Figure 27: 2402MHz, 1Mbps, Lower Band Edge

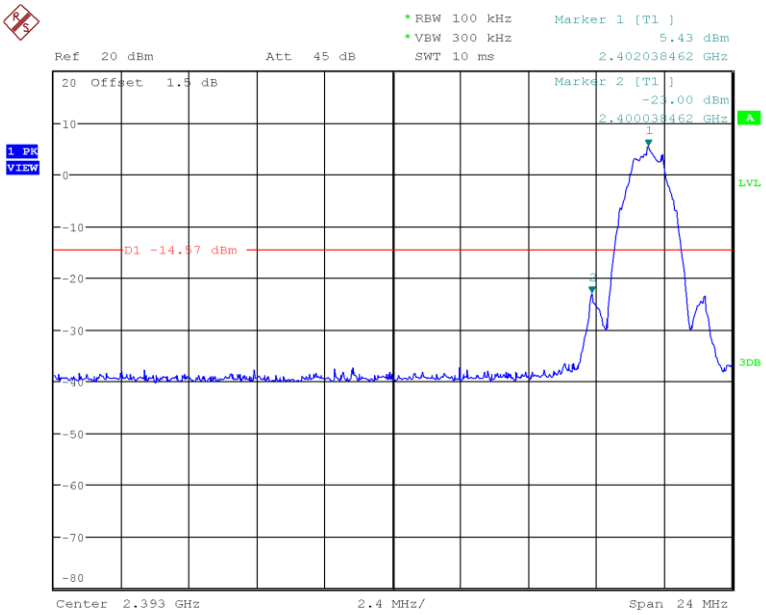


Figure 28: 2402MHz, 2Mbps, Lower Band Edge

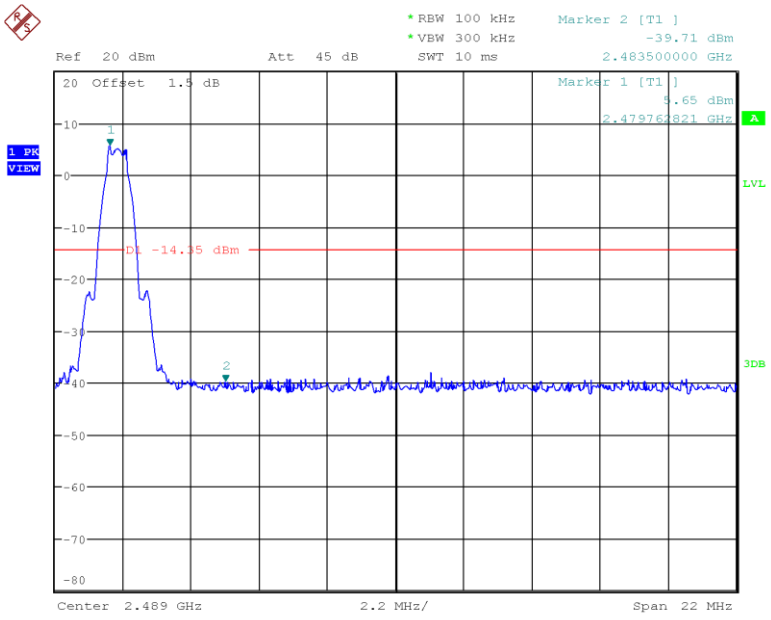


Figure 29: 2480MHz, 1Mbps Upper Band Edge

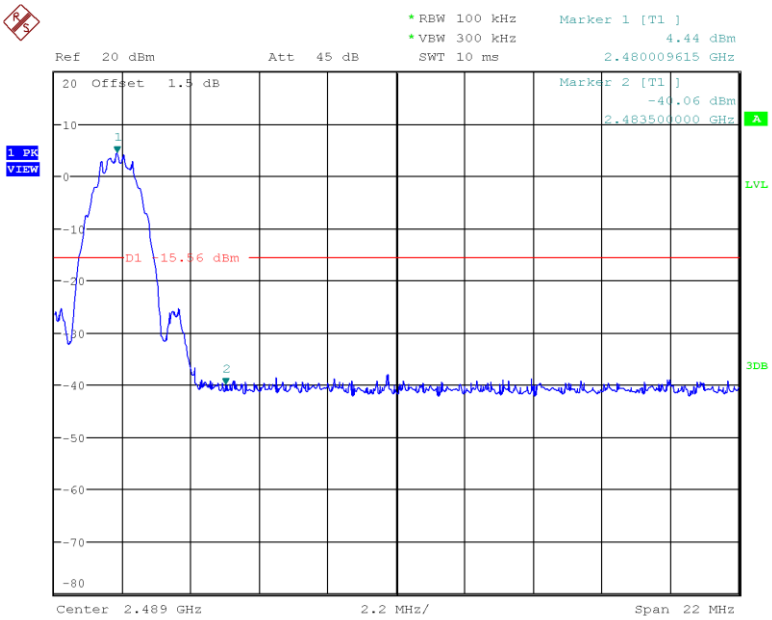


Figure 30: 2480MHz, 2Mbps Upper Band Edge

4.4.3.2 Conducted Spurious

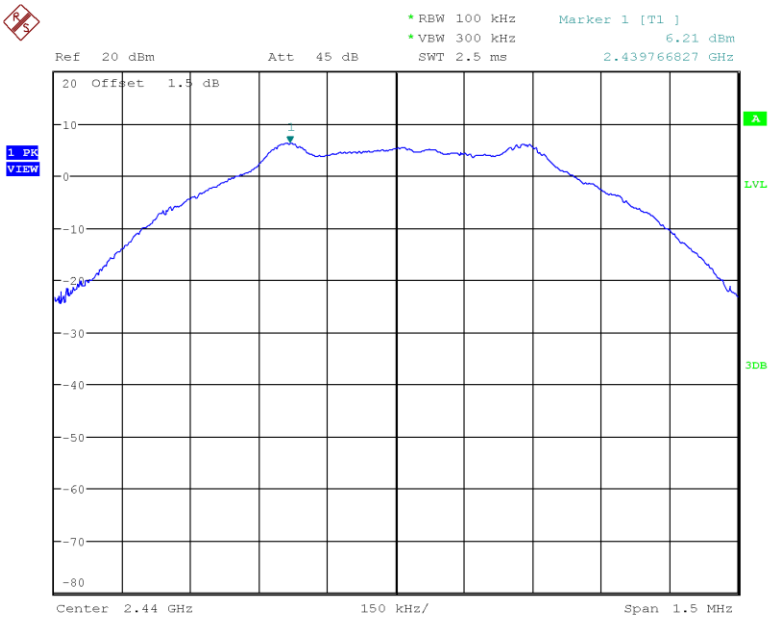


Figure 31: 1Mbps Ref Measurement

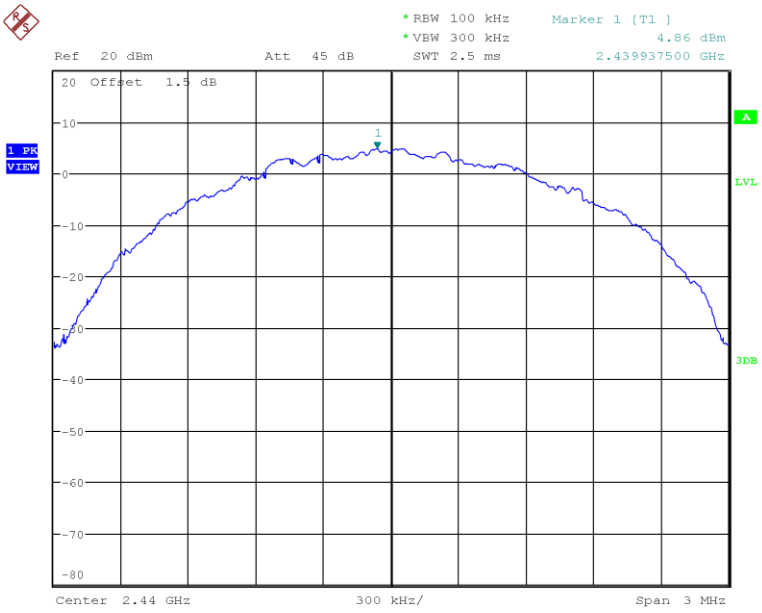


Figure 32: 2Mbps Ref Measurement

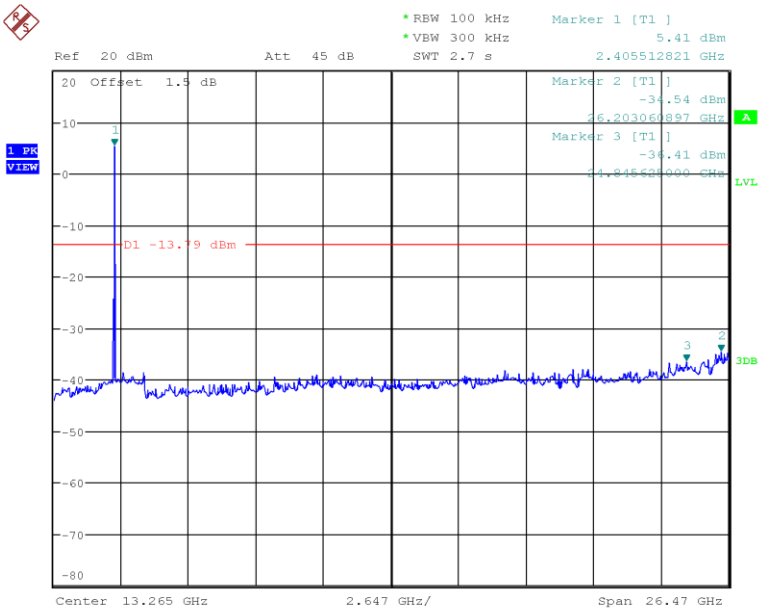


Figure 33: Conducted Emissions, 2402 MHz, 1Mbps

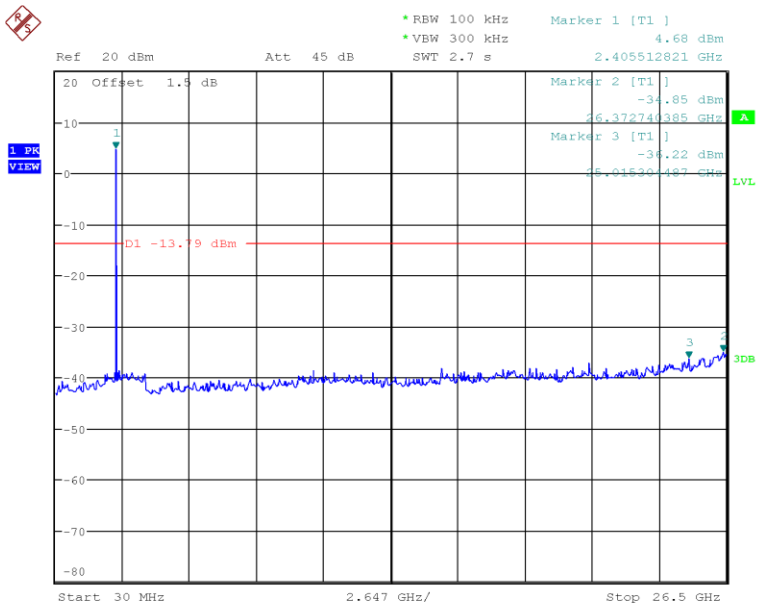


Figure 34: Conducted Emissions, 2440 MHz, 1Mbps

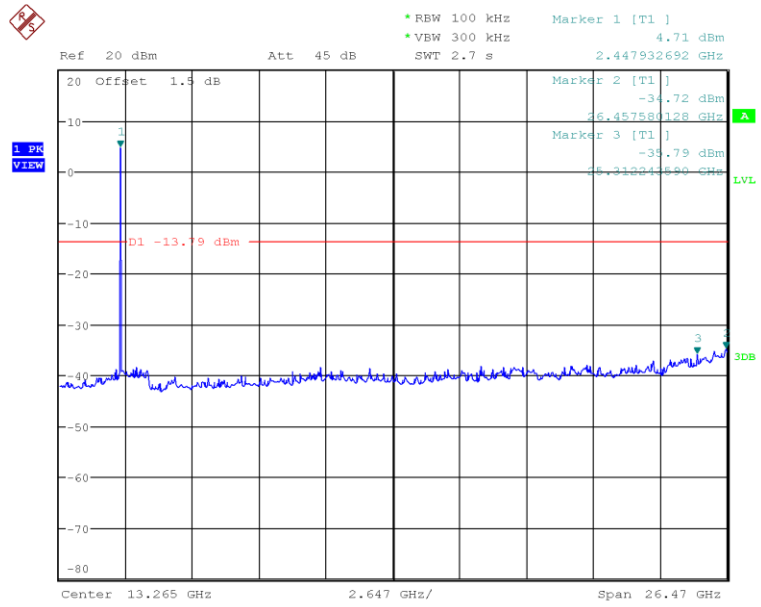


Figure 35: Conducted Emissions, 2480 MHz, 1Mbps

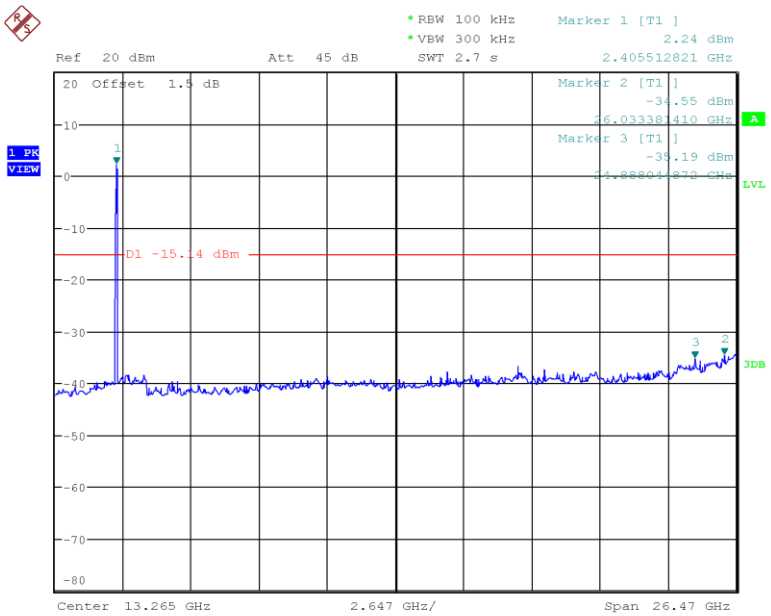


Figure 36: Conducted Emissions, 2402 MHz, 2Mbps

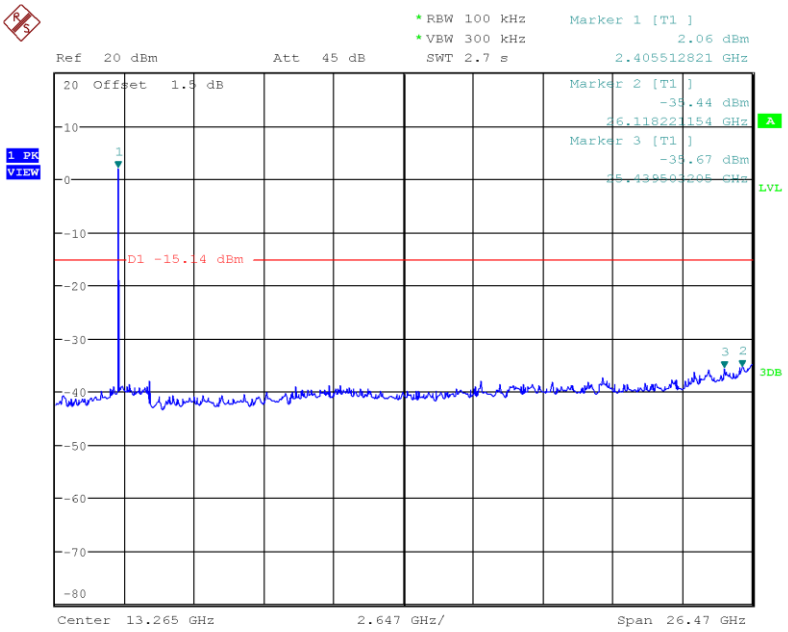


Figure 37: Conducted Emissions, 2440 MHz, 2Mbps

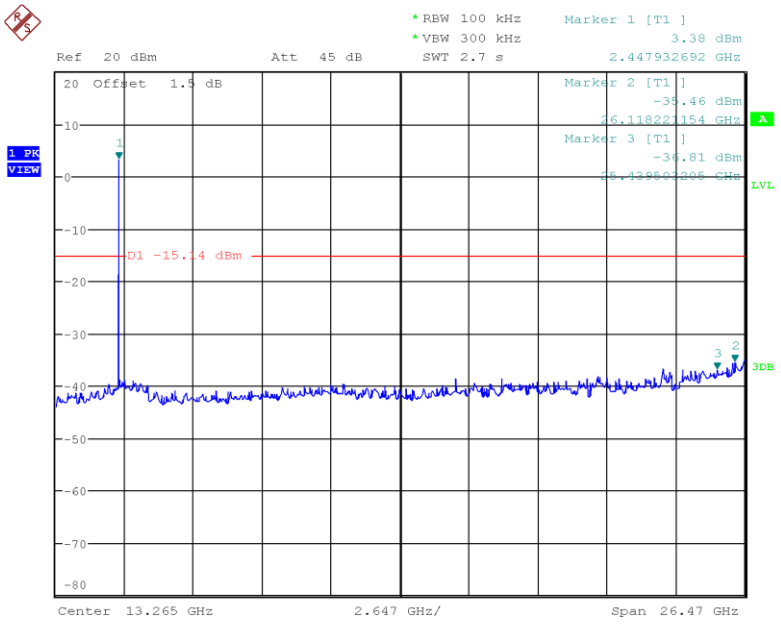


Figure 38: Conducted Emissions, 2480 MHz, 2Mbps

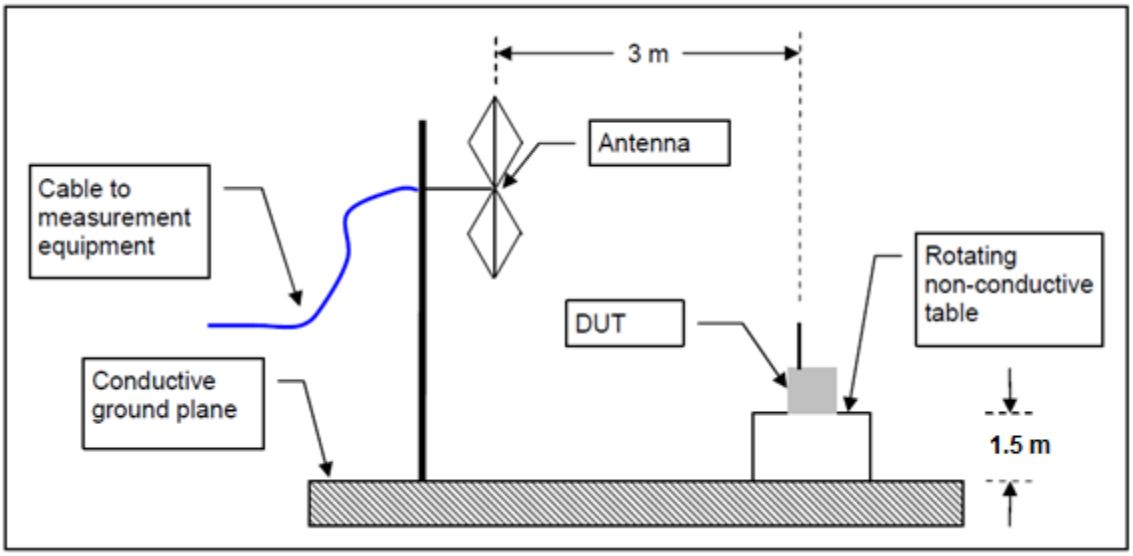
4.5 Out of Band Emissions: Restricted Band Edge

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS-247 Sect. 5.5, RSS-GEN Sect. 8.9 and 8.10.

4.5.1 Test Method

Radiated measurements per ANSI C63.10-2013 Section 6.10.5 were used to measure the undesirable emission requirement in restricted bands. Peak points were found and RMS Average was taken for each point found. The measurement was performed with modulation. This test was conducted on 3 channels in each mode on the EUT. The worst case measurement of each channel is recorded in this report. All channels were tested at highest power settings.

Test Setup



The DUT was stimulated by manufacturer provided test software that is not available to the end user.

4.5.2 Test Results

Test Conditions: Radiated Measurement, Normal Temperature and Voltage
Antenna Type: Removable
Power Setting: +8dBm
Max. Antenna Gain: 1.58 dBi
Test Performed by: Christopher Lee

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2319.880000	43.24	---	74.00	30.76	1000.000	307.0	V	30.0	-3.0
2319.880000	---	26.55	54.00	27.45	1000.000	307.0	V	30.0	-3.0
2338.057600	46.81	---	74.00	27.19	1000.000	150.0	H	81.0	-2.9
2338.057600	---	36.45	54.00	17.55	1000.000	150.0	H	81.0	-2.9
2353.569600	---	28.90	54.00	25.10	1000.000	104.0	H	210.0	-2.7
2353.569600	44.81	---	74.00	29.19	1000.000	104.0	H	210.0	-2.7
2364.198400	---	31.28	54.00	22.72	1000.000	194.0	H	237.0	-2.6
2364.198400	45.54	---	74.00	28.46	1000.000	194.0	H	237.0	-2.6
2370.078400	47.70	---	74.00	26.30	1000.000	153.0	H	79.0	-2.6
2370.078400	---	34.48	54.00	19.52	1000.000	153.0	H	79.0	-2.6
2389.073600	43.97	---	74.00	30.03	1000.000	129.0	V	119.0	-2.5
2389.073600	---	28.01	54.00	25.99	1000.000	129.0	V	119.0	-2.5

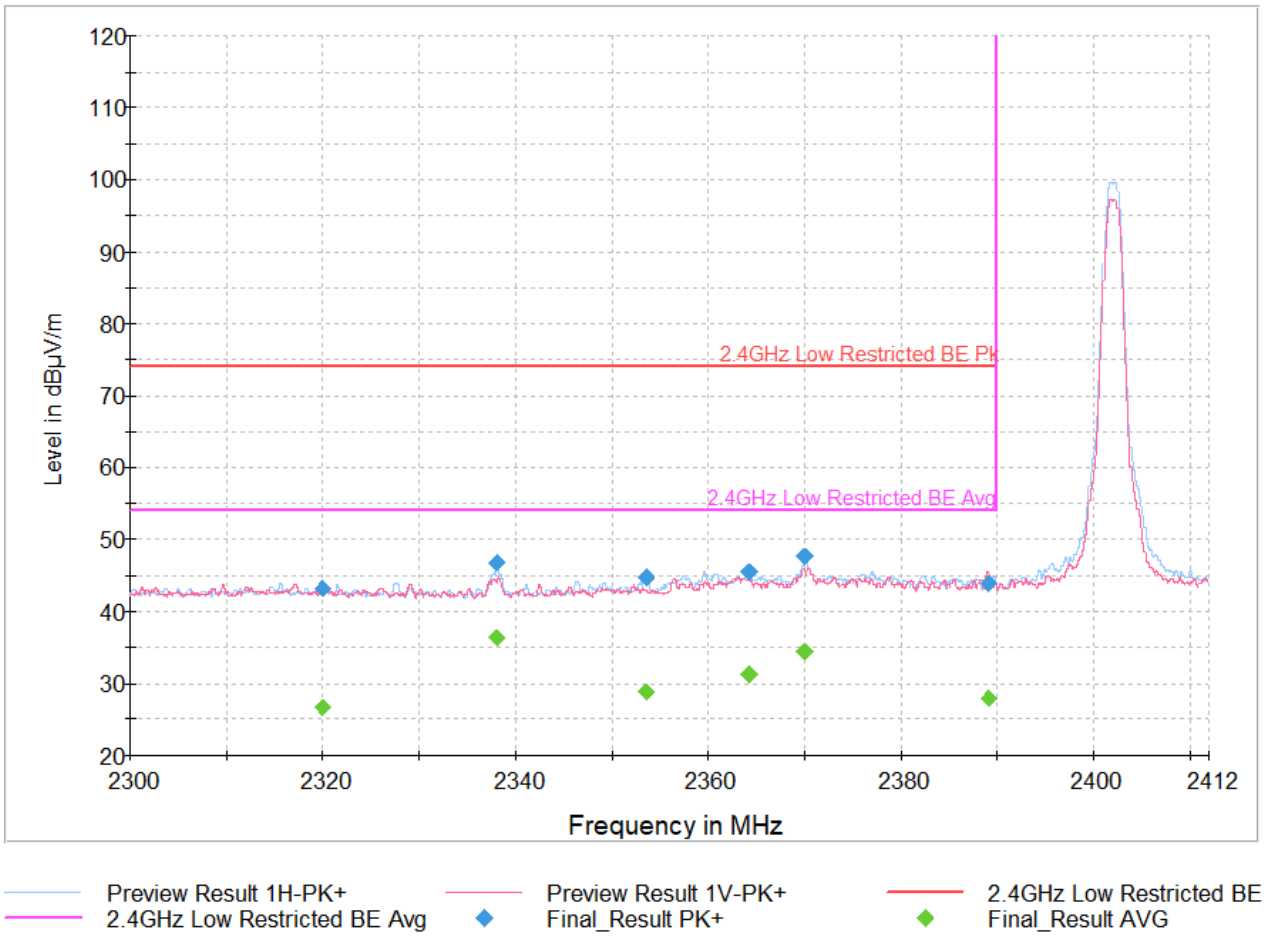


Figure 39: Restricted Band Edge, Low, 2402MHz, 1 Mbps

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2338.080000	45.59	---	74.00	28.41	1000.000	116.0	H	96.0	-2.9
2338.080000	---	33.91	54.00	20.09	1000.000	116.0	H	96.0	-2.9
2363.784000	---	31.66	54.00	22.34	1000.000	192.0	H	78.0	-2.6
2363.784000	45.91	---	74.00	28.09	1000.000	192.0	H	78.0	-2.6
2366.852800	45.12	---	74.00	28.88	1000.000	105.0	H	76.0	-2.6
2366.852800	---	30.39	54.00	23.61	1000.000	105.0	H	76.0	-2.6
2370.011200	47.62	---	74.00	26.38	1000.000	150.0	H	73.0	-2.6
2370.011200	---	33.89	54.00	20.11	1000.000	150.0	H	73.0	-2.6
2384.089600	---	29.06	54.00	24.94	1000.000	106.0	H	265.0	-2.6
2384.089600	44.77	---	74.00	29.23	1000.000	106.0	H	265.0	-2.6
2389.264000	44.37	---	74.00	29.63	1000.000	246.0	H	12.0	-2.5
2389.264000	---	28.79	54.00	25.21	1000.000	246.0	H	12.0	-2.5

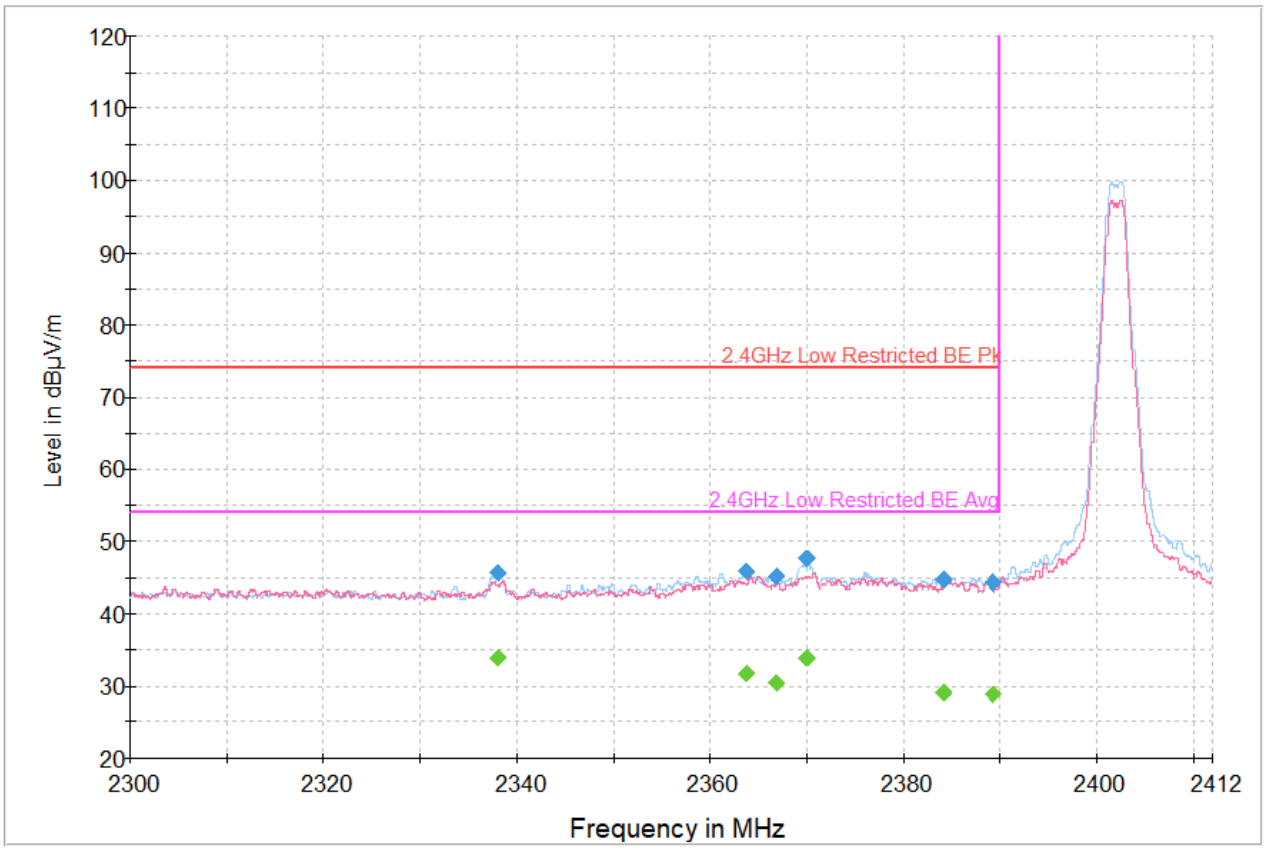


Figure 40: Restricted Band Edge, Low, 2402MHz, 2 Mbps

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.541800	53.24	---	74.00	20.76	1000.000	105.0	H	86.0	-1.9
2483.541800	---	38.62	54.00	15.38	1000.000	105.0	H	86.0	-1.9
2484.714800	---	35.48	54.00	18.52	1000.000	150.0	H	230.0	-1.9
2484.714800	50.25	---	74.00	23.75	1000.000	150.0	H	230.0	-1.9
2498.666600	---	32.43	54.00	21.57	1000.000	100.0	H	93.0	-1.8
2498.666600	47.55	---	74.00	26.45	1000.000	100.0	H	93.0	-1.8
2512.301000	---	35.94	54.00	18.06	1000.000	183.0	H	233.0	-1.6
2512.301000	49.08	---	74.00	24.92	1000.000	183.0	H	233.0	-1.6
2518.221200	---	35.87	54.00	18.13	1000.000	100.0	H	86.0	-1.6
2518.221200	49.20	---	74.00	24.80	1000.000	100.0	H	86.0	-1.6
2543.930600	48.99	---	74.00	25.01	1000.000	195.0	H	77.0	-1.4
2543.930600	---	37.54	54.00	16.46	1000.000	195.0	H	77.0	-1.4

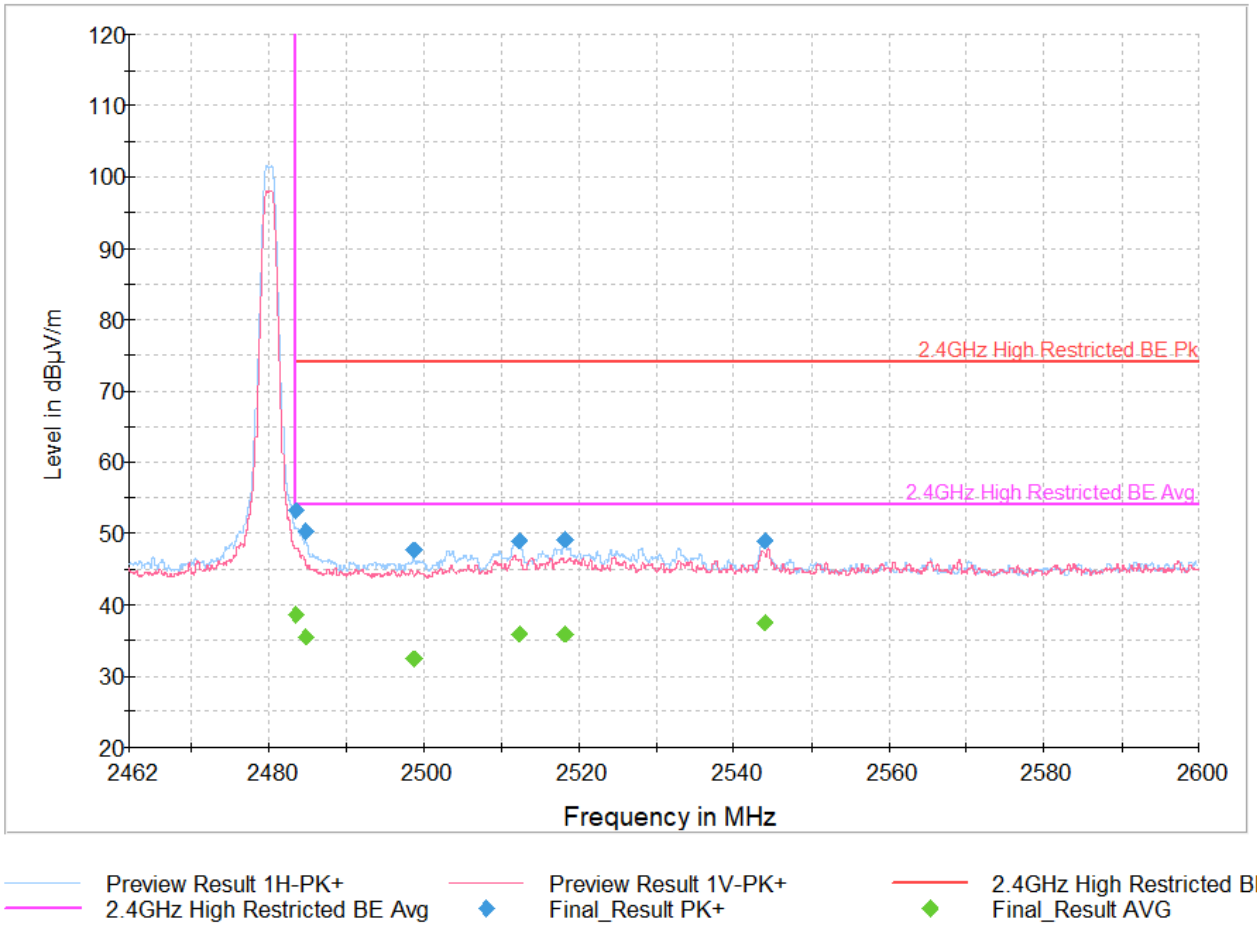


Figure 41: Restricted Band Edge, High, 2480MHz, 1 Mbps

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.500400	---	43.68	54.00	10.32	1000.000	150.0	H	231.0	-1.9
2483.500400	56.81	---	74.00	17.19	1000.000	150.0	H	231.0	-1.9
2483.900600	---	42.69	54.00	11.31	1000.000	150.0	H	235.0	-1.9
2483.900600	56.87	---	74.00	17.13	1000.000	150.0	H	235.0	-1.9
2484.480200	55.68	---	74.00	18.32	1000.000	150.0	H	235.0	-1.9
2484.480200	---	41.34	54.00	12.66	1000.000	150.0	H	235.0	-1.9
2491.076600	48.65	---	74.00	25.35	1000.000	145.0	H	240.0	-1.8
2491.076600	---	34.13	54.00	19.87	1000.000	145.0	H	240.0	-1.8
2511.983600	---	35.87	54.00	18.13	1000.000	140.0	H	261.0	-1.6
2511.983600	49.28	---	74.00	24.72	1000.000	140.0	H	261.0	-1.6
2544.082400	---	37.04	54.00	16.96	1000.000	153.0	H	79.0	-1.4
2544.082400	48.86	---	74.00	25.14	1000.000	153.0	H	79.0	-1.4

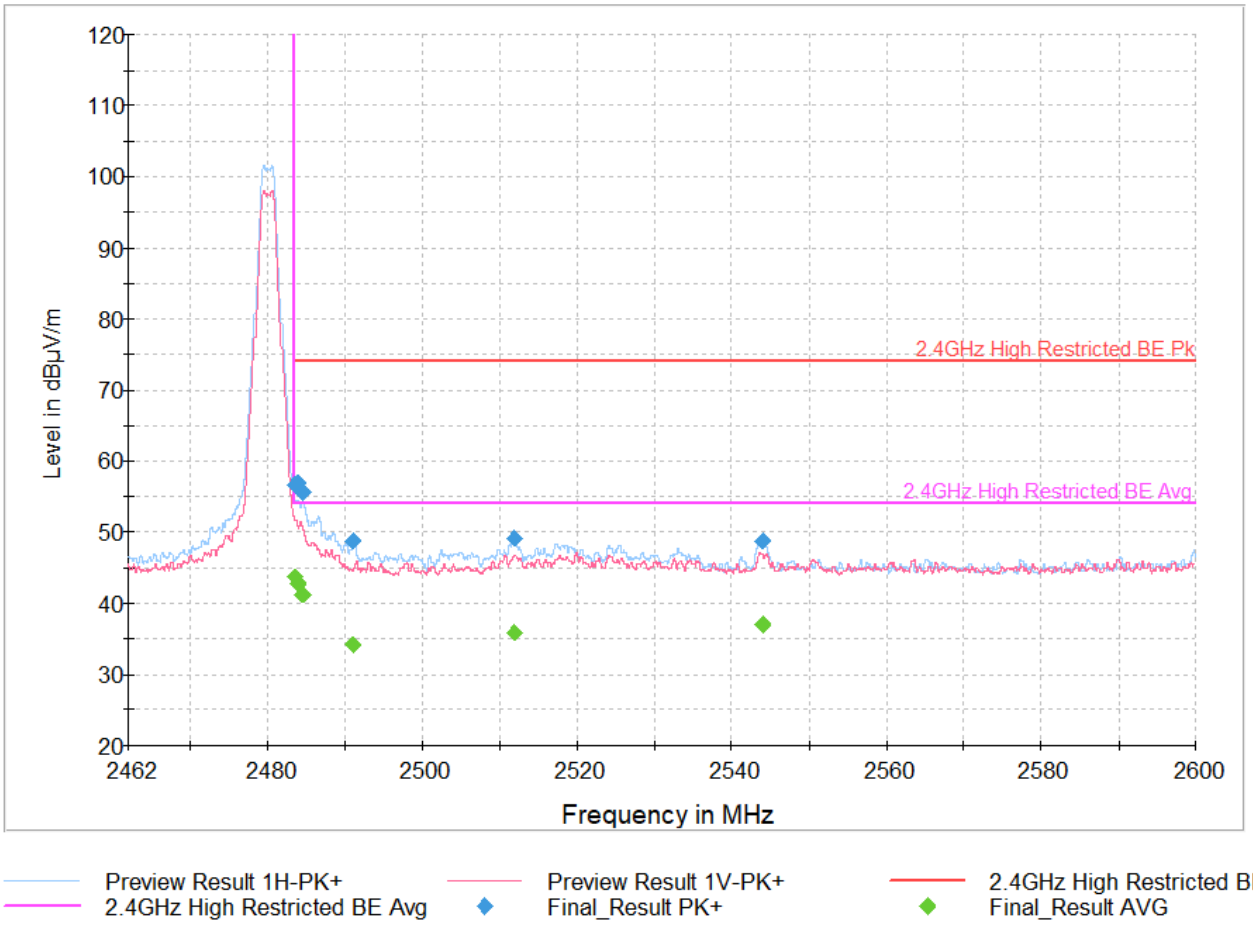


Figure 42: Restricted Band Edge, High, 2480MHz, 2 Mbps

4.6 Transmitter Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS 247 Sect.5.5, RSS-GEN Sect. 8.9 and 8.10.

4.6.1 Test Methodology

4.6.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and Figure 2: ted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

Pre-scans were performed to determine the worst data rate / chains.

4.6.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

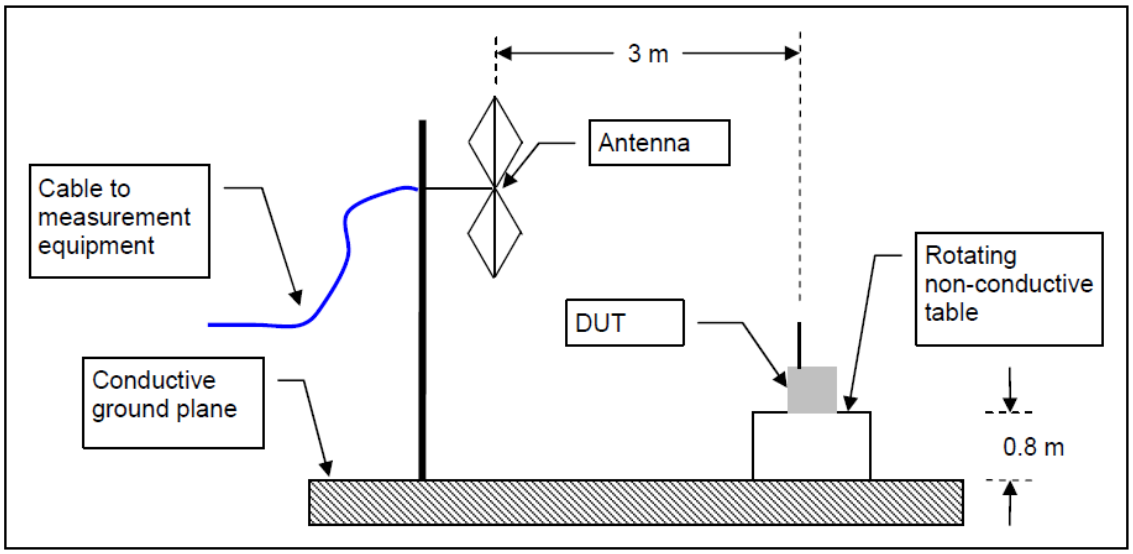
4.6.1.3 Deviations

None.

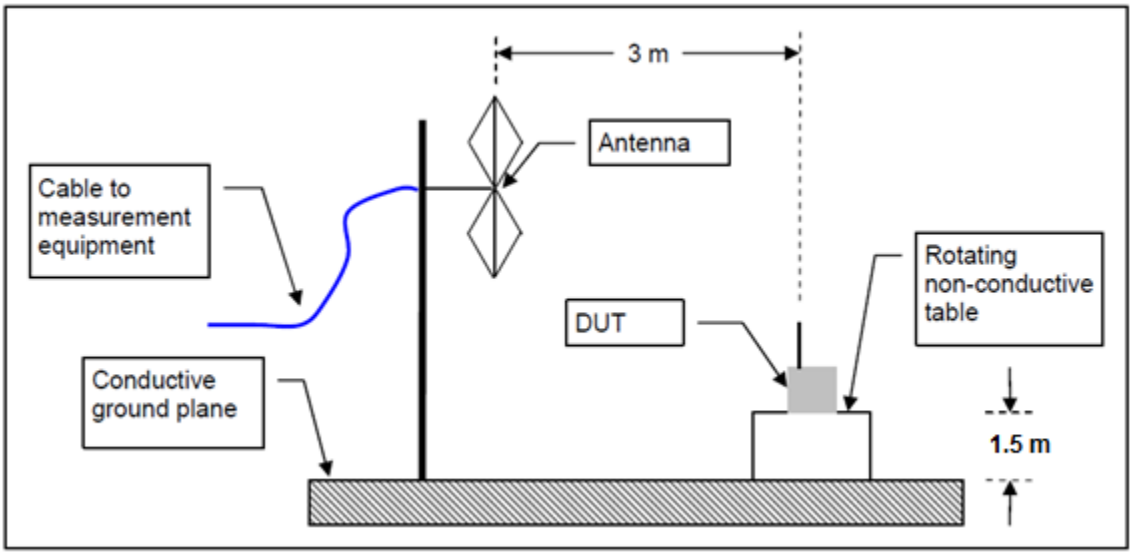
4.6.2 Test Setup:

All tests were conducted at full power on low, middle, and high channels. The DUT was stimulated by manufacturer provided test software that is not available to the end user.

30MHz-1GHz



1-26GHz



4.6.3 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2015 and RSS Gen Sect. 8.9 and 8.10: 2014.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F(kHz)	300
0.490-1.705.....	24000/F(kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

4.6.4 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and test plan.

Frequencies below 30MHz and above 18GHz were investigated and no emissions were found above the noise floor. Both horizontal and vertical polarities were investigated. The results show only the worst case.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Note: The 2.4 GHz notch filter was used to protect the front end of the pre-amp.

4.6.4.1 Measurement Results:

Test Conditions: Radiated Measurement, Normal Temperature and Voltage
Antenna Type: Removable
Power Setting: +8dBm
Max. Antenna Gain: 1.58 dBi
Test Performed by: Christopher Lee

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
60.004550	37.00	40.00	3.00	5000.0	120.000	103.0	V	102.0	-17.1
72.006750	35.22	40.00	4.78	5000.0	120.000	103.0	V	138.0	-18.2
95.992800	39.03	43.52	4.49	5000.0	120.000	103.0	V	180.0	-17.7
120.006100	40.65	43.52	2.87	5000.0	120.000	103.0	V	-180.0	-10.7
144.016200	41.23	43.52	2.29	5000.0	120.000	103.0	V	180.0	-14.2
167.987150	41.68	43.52	1.84	5000.0	120.000	103.0	V	180.0	-13.3

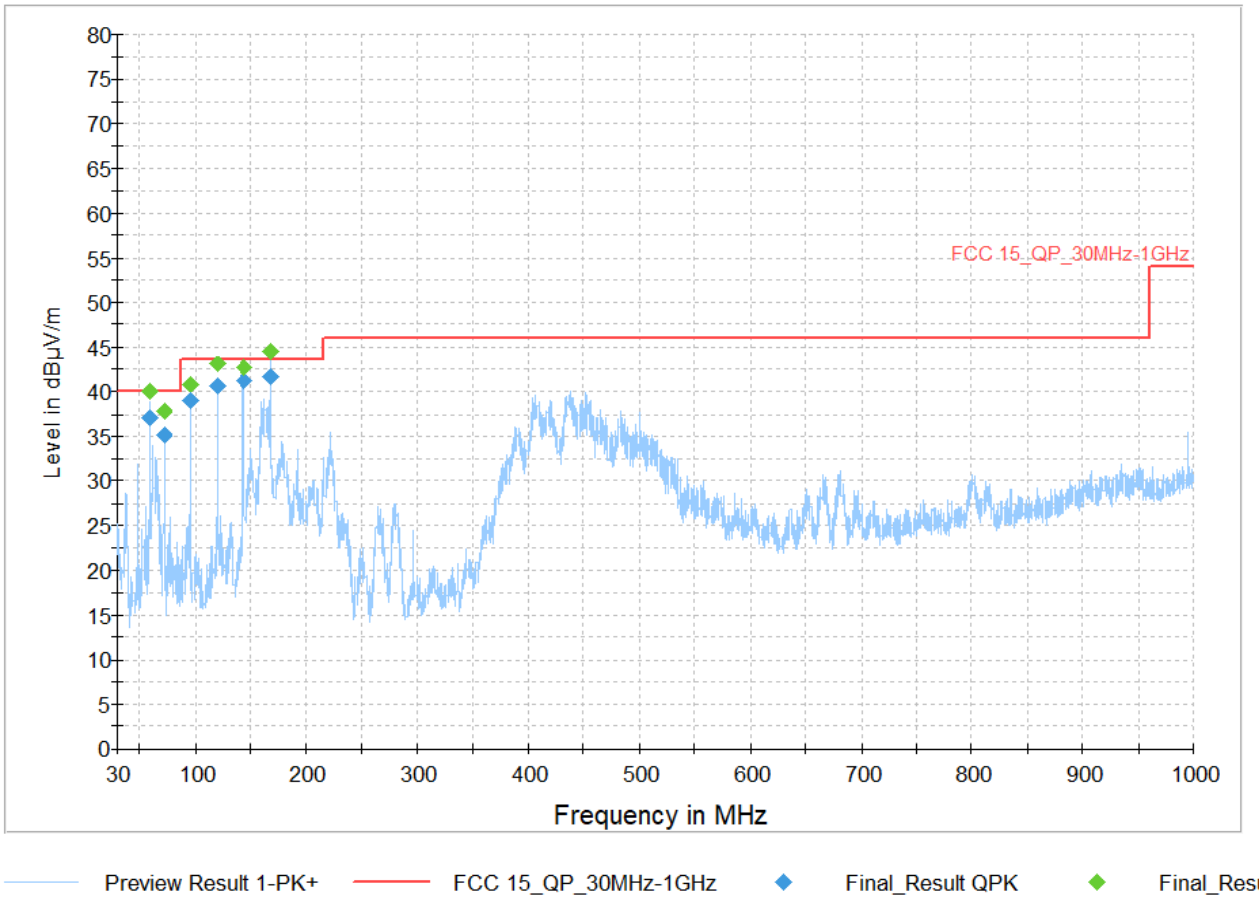


Figure 43: Radiated Spurious Emissions 30MHz – 1GHz, 2402MHz, 1Mbps

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
60.000950	36.19	40.00	3.81	5000.0	120.000	104.0	V	60.0	-17.1
71.994100	35.78	40.00	4.22	5000.0	120.000	104.0	V	-180.0	-18.2
95.983700	38.97	43.52	4.55	5000.0	120.000	104.0	V	45.0	-17.7
120.011750	42.12	43.52	1.40	5000.0	120.000	104.0	V	82.0	-10.7
144.256900	43.08	43.52	0.44	5000.0	120.000	104.0	V	91.0	-14.3
167.956450	41.48	43.52	2.04	5000.0	120.000	104.0	V	106.0	-13.3

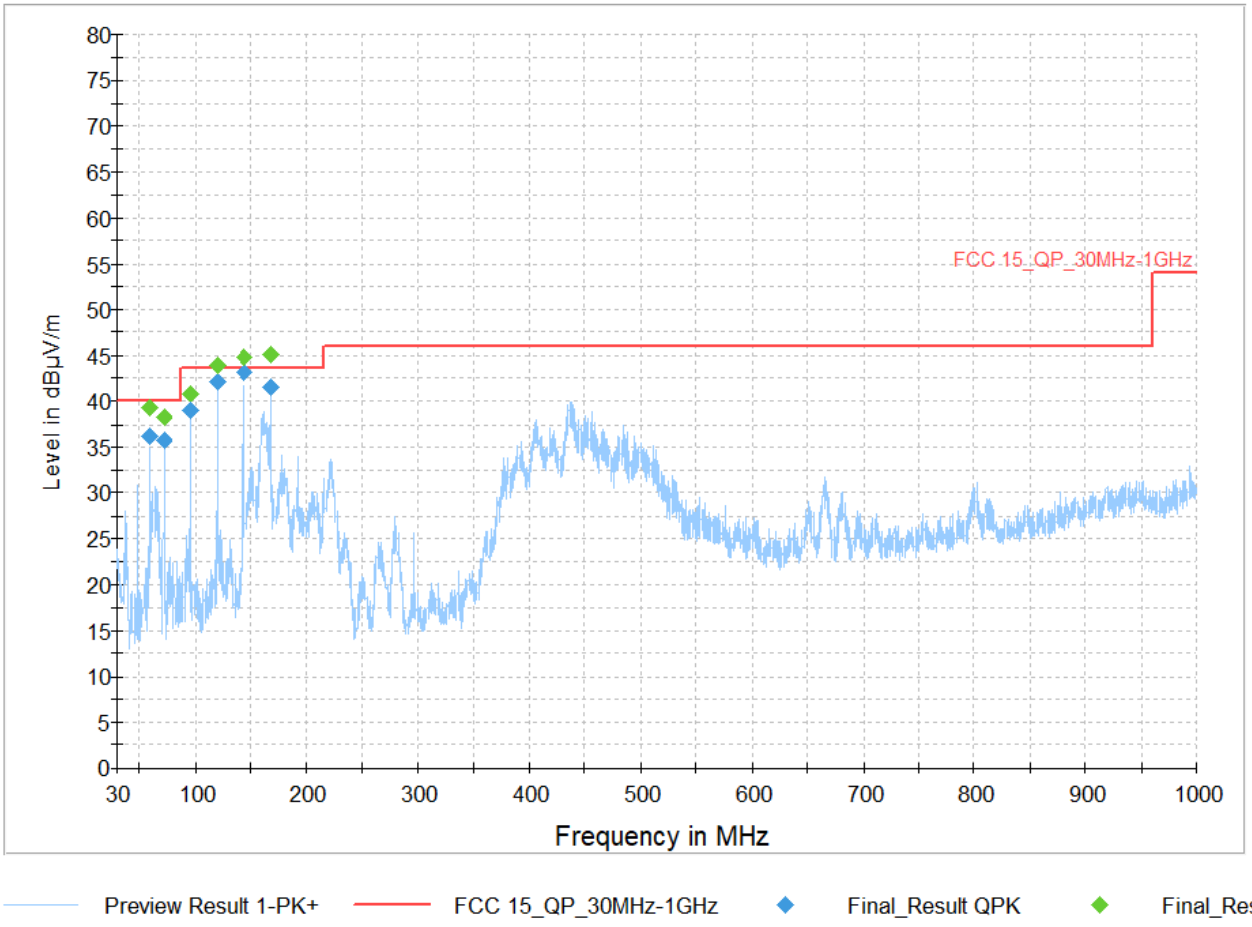


Figure 44: Radiated Spurious Emissions 30MHz – 1GHz, 2440MHz, 2Mbps

Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1855.817950	---	19.43	54.00	34.57	1000.0	1000.000	152.0	V	180.0	-32.4
1855.817950	32.46	---	74.00	41.54	1000.0	1000.000	152.0	V	180.0	-32.4
4803.531950	---	53.87	54.00	0.13	1000.0	1000.000	152.0	V	43.0	-24.3
4803.531950	60.29	---	74.00	13.71	1000.0	1000.000	152.0	V	43.0	-24.3
7205.293000	52.68	---	74.00	21.32	1000.0	1000.000	152.0	V	101.0	-20.6
7205.293000	---	44.25	54.00	9.75	1000.0	1000.000	152.0	V	101.0	-20.6
9607.162000	---	42.44	54.00	11.56	1000.0	1000.000	152.0	H	180.0	-16.4
9607.162000	51.82	---	74.00	22.18	1000.0	1000.000	152.0	H	180.0	-16.4
14159.350000	48.34	---	74.00	25.66	1000.0	1000.000	151.0	H	36.0	-11.2
14159.350000	---	35.20	54.00	18.80	1000.0	1000.000	151.0	H	36.0	-11.2
17944.621950	51.84	---	74.00	22.16	1000.0	1000.000	152.0	H	-180.0	-6.0
17944.621950	---	38.80	54.00	15.20	1000.0	1000.000	152.0	H	-180.0	-6.0

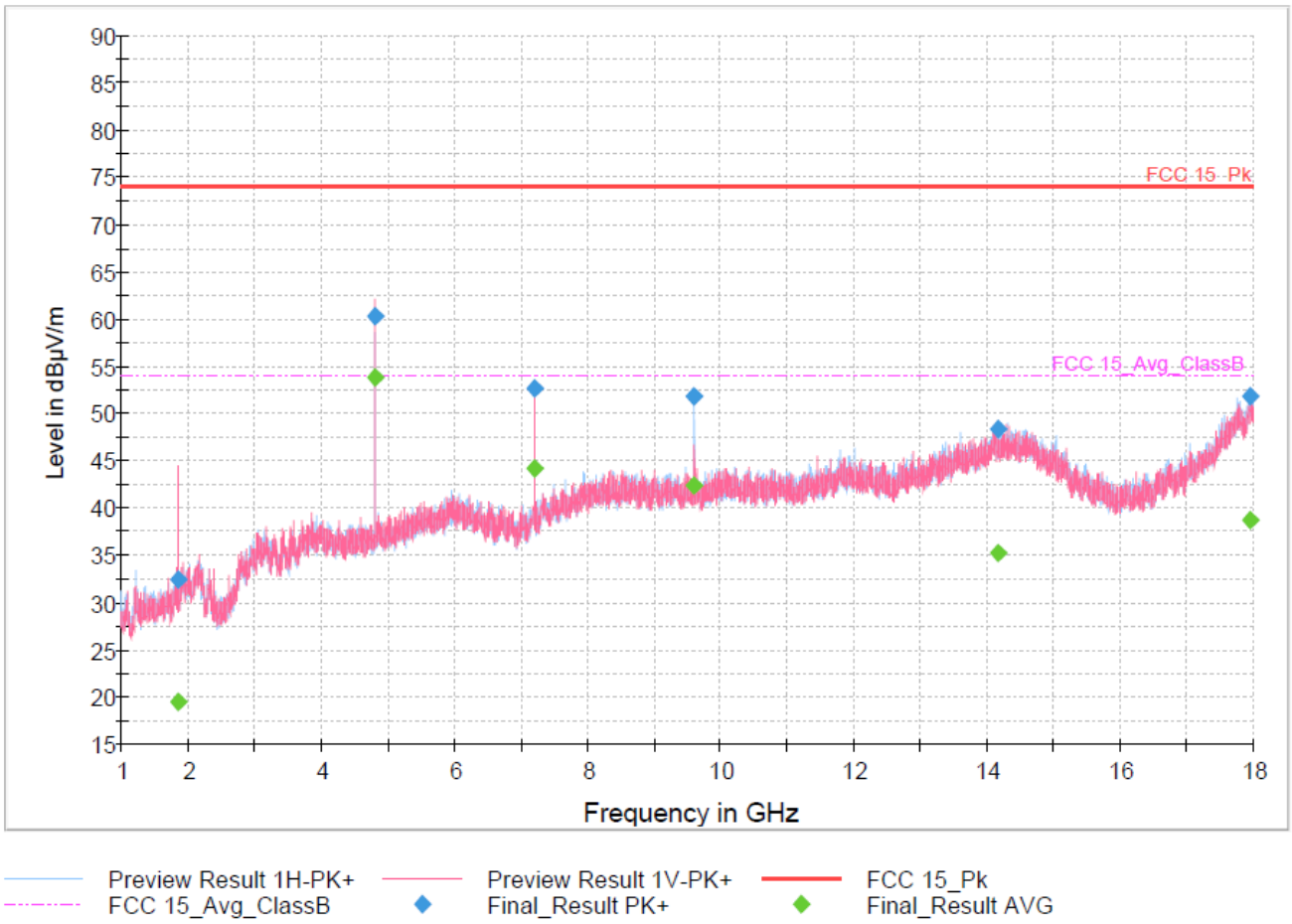


Figure 45: Radiated Spurious Emissions 1GHz - 18GHz, 2402MHz, 1Mbps

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2439.878971	---	40.05	54.00	13.95	1000.000	105.0	H	84.0	-0.1
2439.878971	44.38	---	74.00	29.62	1000.000	105.0	H	84.0	-0.1
4879.824000	54.49	---	74.00	19.51	1000.000	196.0	H	237.0	5.8
4879.824000	---	49.14	54.00	4.86	1000.000	196.0	H	237.0	5.8
7319.500000	50.68	---	74.00	23.32	1000.000	100.0	H	128.0	8.0
7319.500000	---	42.53	54.00	11.47	1000.000	100.0	H	128.0	8.0
9761.087029	57.63	---	74.00	16.37	1000.000	100.0	V	170.0	11.7
9761.087029	---	48.77	54.00	5.23	1000.000	100.0	V	170.0	11.7
17535.500971	55.97	---	74.00	18.03	1000.000	268.0	H	199.0	20.4
17535.500971	---	42.80	54.00	11.20	1000.000	268.0	H	199.0	20.4
17829.359000	---	42.65	54.00	11.35	1000.000	182.0	V	81.0	20.6
17829.359000	55.43	---	74.00	18.57	1000.000	182.0	V	81.0	20.6

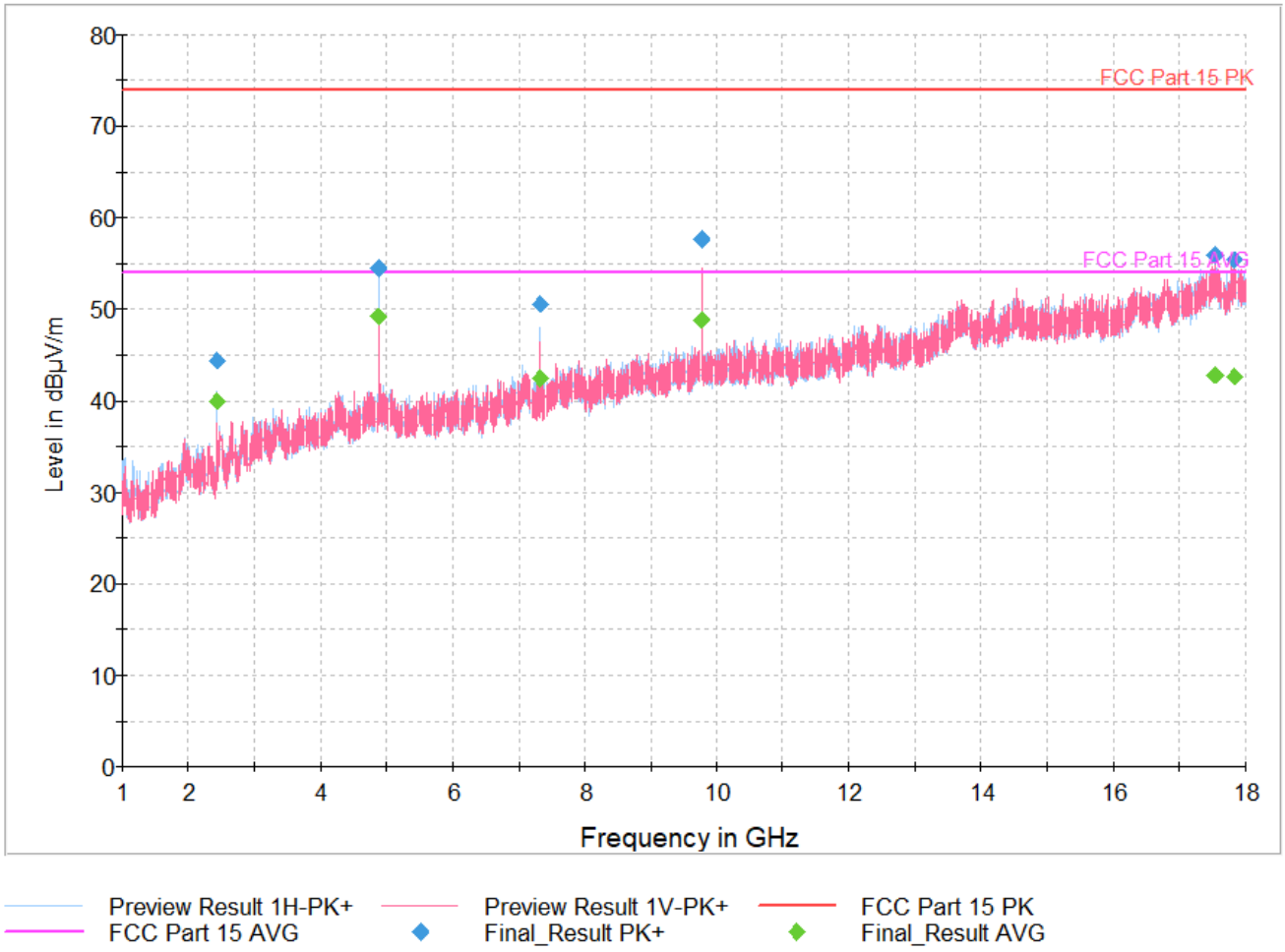


Figure 46: Radiated Spurious Emissions 1GHz - 18GHz, 2440MHz, 1Mbps

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2479.795971	47.48	---	74.00	26.52	1000.000	150.0	H	233.0	0.3
2479.795971	---	42.98	54.00	11.02	1000.000	150.0	H	233.0	0.3
4960.000000	---	41.55	54.00	12.45	1000.000	197.0	H	238.0	6.2
4960.000000	48.57	---	74.00	25.43	1000.000	197.0	H	238.0	6.2
7440.646971	54.13	---	74.00	19.87	1000.000	104.0	H	129.0	8.5
7440.646971	---	46.92	54.00	7.08	1000.000	104.0	H	129.0	8.5
9921.107000	57.03	---	74.00	16.98	1000.000	100.0	V	151.0	11.6
9921.107000	---	48.02	54.00	5.98	1000.000	100.0	V	151.0	11.6
17570.500000	---	42.70	54.00	11.31	1000.000	170.0	V	254.0	20.3
17570.500000	55.51	---	74.00	18.49	1000.000	170.0	V	254.0	20.3
17867.000000	56.00	---	74.00	18.00	1000.000	333.0	H	225.0	20.7
17867.000000	---	42.36	54.00	11.64	1000.000	333.0	H	225.0	20.7

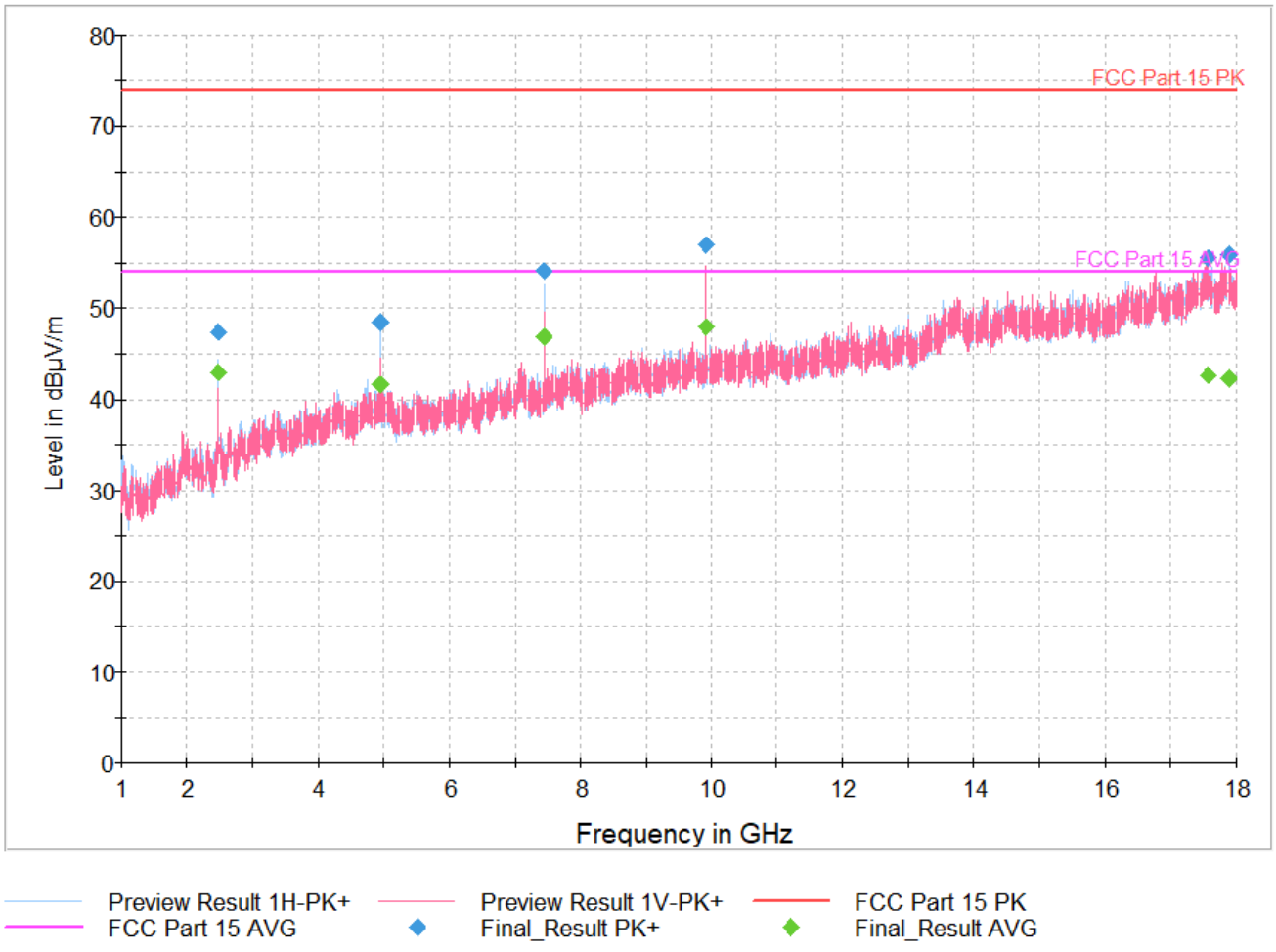


Figure 47: Radiated Spurious Emissions 1GHz - 18GHz, 2480MHz, 1Mbps

Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4805.043000	60.77	---	74.00	13.23	1000.0	1000.000	152.0	V	42.0	-24.3
4805.043000	---	53.46	54.00	0.54	1000.0	1000.000	152.0	V	42.0	-24.3
7204.595000	50.52	---	74.00	23.48	1000.0	1000.000	152.0	V	131.0	-20.6
7204.595000	---	40.97	54.00	13.03	1000.0	1000.000	152.0	V	131.0	-20.6
9610.110950	---	39.39	54.00	14.61	1000.0	1000.000	104.0	H	-180.0	-16.4
9610.110950	50.34	---	74.00	23.67	1000.0	1000.000	104.0	H	-180.0	-16.4
14132.149050	49.43	---	74.00	24.57	1000.0	1000.000	103.0	H	-180.0	-11.2
14132.149050	---	35.84	54.00	18.16	1000.0	1000.000	103.0	H	-180.0	-11.2
17738.700000	50.66	---	74.00	23.34	1000.0	1000.000	103.0	H	-180.0	-7.0
17738.700000	---	37.69	54.00	16.31	1000.0	1000.000	103.0	H	-180.0	-7.0
17985.200000	---	38.82	54.00	15.18	1000.0	1000.000	151.0	H	-180.0	-5.8
17985.200000	51.71	---	74.00	22.29	1000.0	1000.000	151.0	H	-180.0	-5.8

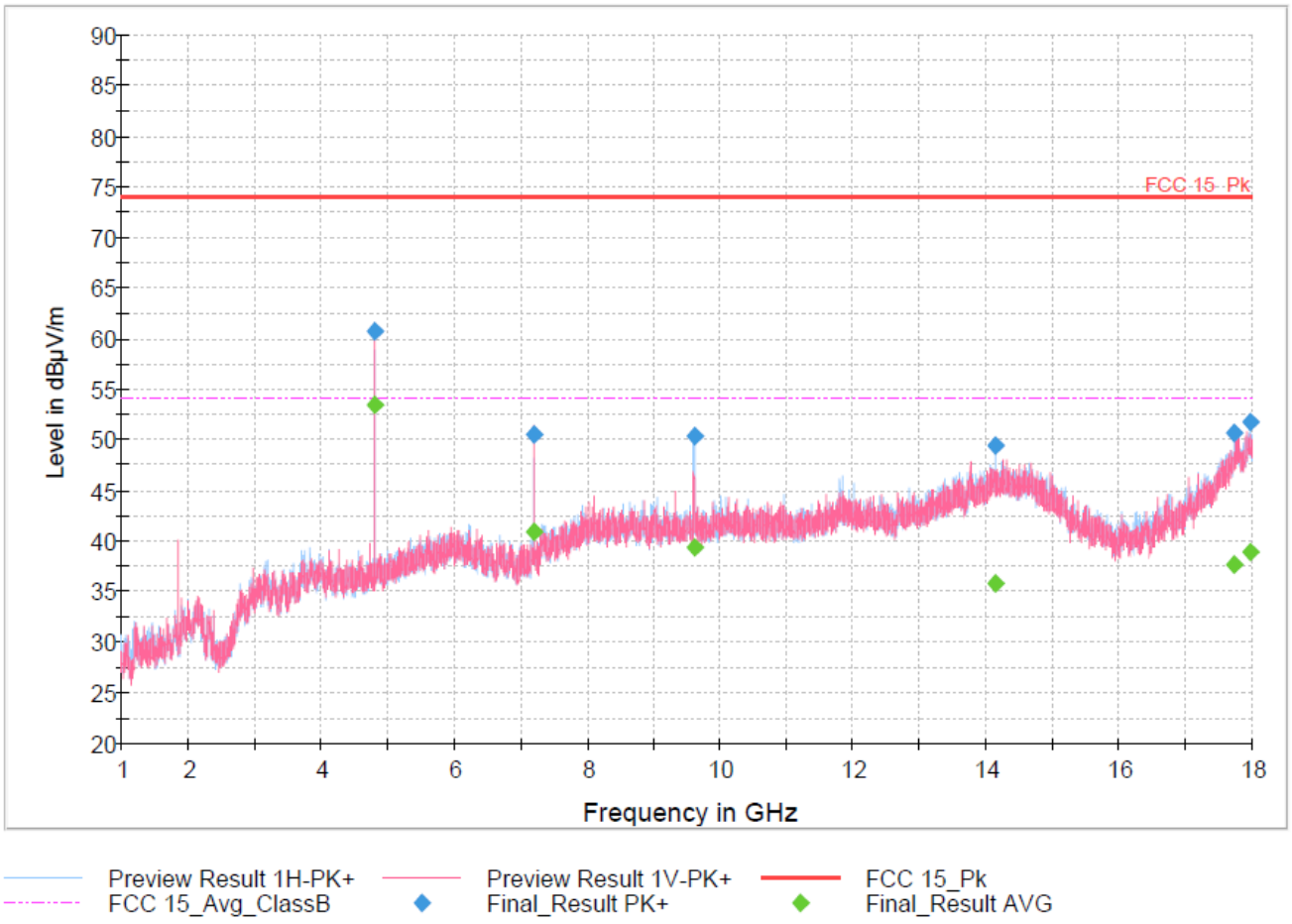


Figure 48: Radiated Spurious Emissions 1GHz - 18GHz, 2402MHz, 2Mbps

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2440.000000	---	38.87	54.00	15.13	1000.000	104.0	H	91.0	-0.1
2440.000000	44.18	---	74.00	29.82	1000.000	104.0	H	91.0	-0.1
4878.831971	54.04	---	74.00	19.96	1000.000	195.0	H	235.0	5.8
4878.831971	---	45.49	54.00	8.51	1000.000	195.0	H	235.0	5.8
7321.553000	50.45	---	74.00	23.55	1000.000	131.0	H	126.0	8.0
7321.553000	---	40.30	54.00	13.70	1000.000	131.0	H	126.0	8.0
9762.062029	57.49	---	74.00	16.51	1000.000	100.0	V	169.0	11.7
9762.062029	---	47.90	54.00	6.10	1000.000	100.0	V	169.0	11.7
17564.500000	---	42.74	54.00	11.26	1000.000	150.0	V	66.0	20.3
17564.500000	55.90	---	74.00	18.10	1000.000	150.0	V	66.0	20.3
17831.000971	54.95	---	74.00	19.05	1000.000	345.0	H	127.0	20.6
17831.000971	---	42.64	54.00	11.36	1000.000	345.0	H	127.0	20.6

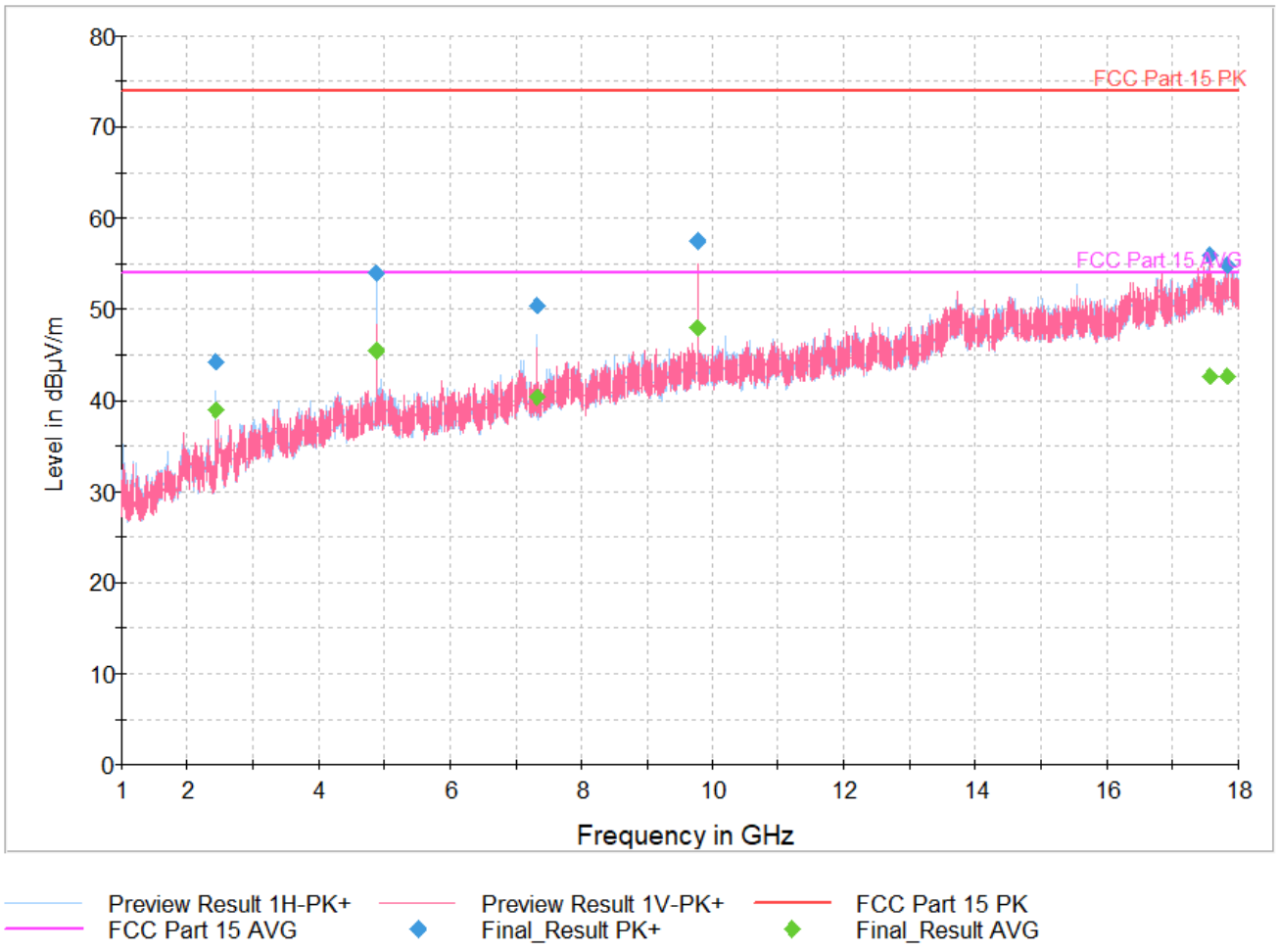


Figure 49: Radiated Spurious Emissions 1GHz - 18GHz, 2440MHz, 2Mbps

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4959.355000	48.24	---	74.00	25.76	1000.000	100.0	H	109.0	6.2
4959.355000	---	38.98	54.00	15.02	1000.000	100.0	H	109.0	6.2
7439.000000	---	46.03	54.00	7.97	1000.000	119.0	H	124.0	8.5
7439.000000	53.18	---	74.00	20.82	1000.000	119.0	H	124.0	8.5
9918.148000	55.39	---	74.00	18.61	1000.000	100.0	V	16.0	11.6
9918.148000	---	45.39	54.00	8.61	1000.000	100.0	V	16.0	11.6
9921.500971	55.29	---	74.00	18.71	1000.000	104.0	V	190.0	11.6
9921.500971	---	47.15	54.00	6.85	1000.000	104.0	V	190.0	11.6
17554.710000	55.40	---	74.00	18.60	1000.000	131.0	H	30.0	20.4
17554.710000	---	42.69	54.00	11.31	1000.000	131.0	H	30.0	20.4
17859.000000	---	42.55	54.00	11.45	1000.000	254.0	V	86.0	20.7
17859.000000	55.35	---	74.00	18.65	1000.000	254.0	V	86.0	20.7

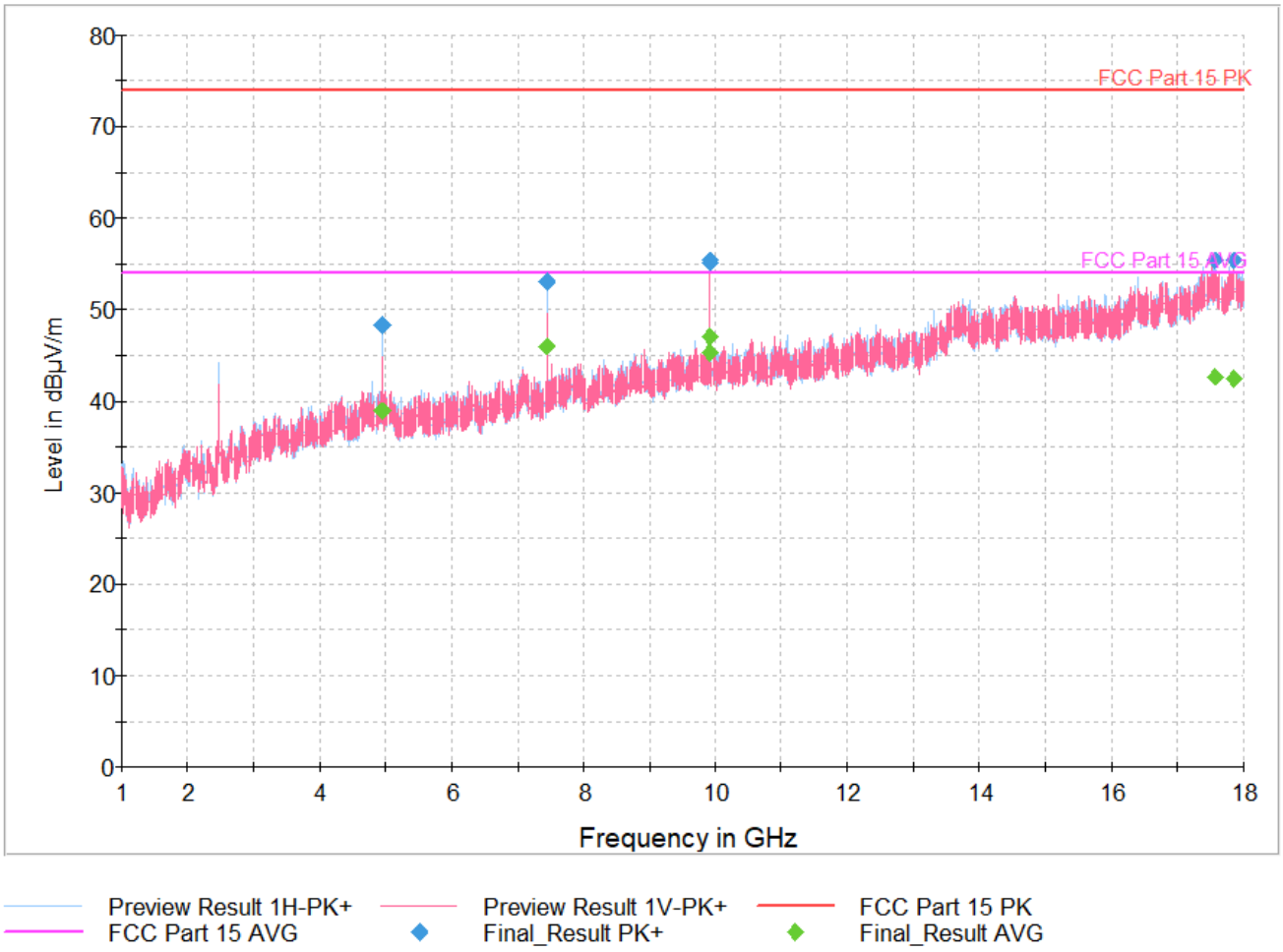


Figure 50: Radiated Spurious Emissions 1GHz - 18GHz, 2480MHz, 2Mbps

4.7 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.10: 2013. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207: 2021 and RSS Gen: 2019 Sect. 8.8.

4.7.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50μH / 50Ω LISNs.

The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

4.7.1.1 Deviations

There were no deviations from this test methodology.

4.7.2 Test Results

Test is not applicable since the EUT is DC powered by a battery.

5 Test Equipment List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yyyy	Next Cal mm/dd/yyyy
Spectrum Analyzer	Rohde & Schwarz	FSU26.5	1166.1660.26	02/24/2021	02/24/2022
EMI Receiver	Rohde & Schwarz	ESW44	838399	02/12/2021	02/12/2022
Preamplifier, 9 kHz – 1 GHz	Sonoma	310N	213221	08/06/2020	08/06/2022
Bilog Antenna	Sunol Sciences	JB3	A061907	02/12/2021	02/12/2022
Preamplifier – 1-18GHz	Miteq	AMF-70-01001800-30-10P-L	2074297	02/12/2021	02/12/2022
Horn Antenna	Sunol Sciences	DRH-118	A040806	06/17/2020	06/172022
Preamplifier – 1-10GHz	HP	8449B	3008A01013	06/08/2020	06/08/2022
Horn Antenna	EMCO	RA42-K-F-B-C	100011	03/04/2019	03/04/2021
Amplifier	Rohde & Schwarz	TS-PR26	100011	06/13/2020	06/13/2022
2.4GHZ Band Filter	Microtronics	BRM50702	009	N/A (See Note)	

Note: Equipment is characterized before use.

6 EMC Test Plan

6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer (information supplied by the customer and can affect the validity of results) so that the test laboratory may perform the requested testing.

6.2 Customer

The information in the following tables is required, as it should appear in the final test report.

Table 6: Customer Information

Company Name	Hunter Douglas Window Fashions Division Division
Address	1 Duette Way
City, State, Zip	Broomfield, CO, 80020
Country	USA

Table 7: Technical Contact Information

Name	Mike Rockwood
E-mail	mike.rockwood@hunterdouglas.com
Phone	651-528-1165

6.3 Equipment Under Test (EUT)

The information provided in the following table should be listed as it should appear in the final report. For those products that have only a model name, list the model number as *non-applicable* and vice-versa.

Table 8: EUT Designation

Product Name	Powerview Motorized Shades
Model Number	1004000722, 1012000246, 1012000416, 1012000236, 1012000369
Product Description	The 1004000722, 1012000246, 1012000416, 1012000236, 1012000369 is assembled into various motor assemblies and fabricated into Hunter Douglas window coverings that include a fabric member that is rolled around an aluminum tube, or stacked on itself without a tube. The DC brushed motor rotates the tube to deploy and retract the fabric. The system is powered by 12-18VDC via DC power supply or primary batteries. This power is fed to a solid state H bridge to switch power to the DC brushed motor. Torque and speed are monitored and controlled with the use of hall sensors/ quadrature encoder and current measurement. The input power is dropped by a 3.3V switching power supply at 2MHz to feed power to the logic level components of the system. User inputs to the system include a push button on the motor module, a TTL level serial port, and 2.4GHz RF signals. The RF protocol used is Bluetooth 5 (Low Energy) and is implemented with Nordic NRF52840 series SoC (system on chips). Model 1012000416 is considered worst case and used for testing.

6.4 Product Specifications

The information provided in the following table should be listed as it should appear in the final report.

Table 9: EUT Specifications

EUT Specifications	
DC Power Input	3.3 VDC (powered by battery)
Multiple Feeds:	☐ Yes and how many ☒ No
Product Marketing Name (PMN)	Powerview Motorized Shades
Hardware Version Identification Number (HVIN)	1.0
Firmware Version Identification Number (FVIN)	1.0.0
Operating Modes	Bluetooth Low Energy
Transmitter Frequency Band	2400 MHz to 2483.5 MHz
Power Setting @ Operating Channel	+8dBm
Antenna Type	Removable Antenna
Antenna Gain	1.58 dBi
Modulation Type	☐ AM ☐ FM ☐ DSSS ☒ OFDM ☒ Other describe: GFSK
Data Rate	1 Mbps, 2Mbps
TX/RX Chain (s)	1
Type of Equipment	☐ Table Top ☒ Wall-mount ☐ Floor standing cabinet ☐ Other:
Note: Information supplied by the customer and can affect the validity of results.	

Table 10: Antenna Information

Number	Antenna Type	Description	Max Gain (dBi)
1	Removable	Internal	1.58

Table 11: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
USB Cable	Serial to USB	☐ Yes	☒ Metric: <3.0m	☒ M
Note: Cable required for EUT configuration for regulatory test mode. 3pin to USB cable not utilized within final product. EUT powered via DC power supply during testing.				

Table 12: Accessory Equipment

Equipment	Manufacturer	Model	Serial	Comment
USB to Serial Connector cable	N/A (generic)	N/A (generic)	N/A	Used between test cases to configure EUT operational test mode.
Note: None.				

Table 13: Ancillary Equipment (used for test purposes only)

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Lenovo	X201	N/A	Setup EUT operating channels via serial connection to EUT
Note: None.				

Table 14: Description of Sample used for Testing

Model	Serial Number	Configuration	Used For
1012000416	N/A	Integrated Antenna	Radiated Emissions, Radiated Band Edge
		Direct via temporary SMA connector	Transmit Power, Occupied Bandwidth, Out of Band Emission, PSD, Duty Cycle

Table 15: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Description
1012000416	Removable	Transmit	EUT Flat
Note: EUT was tested on its X-Axis as this was worse case			

6.5 Test Specifications

Table 16: Test Specifications

Emissions and Immunity	
Standard	**Requirement**
CFR 47 Part 15.247: 2021	All
RSS 247 Issue 2, 2017	All

END OF REPORT